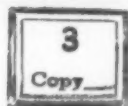


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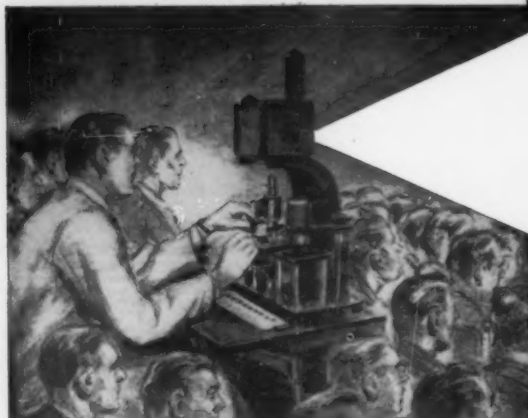
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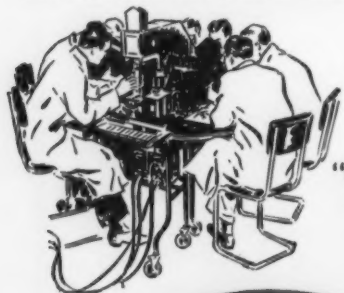
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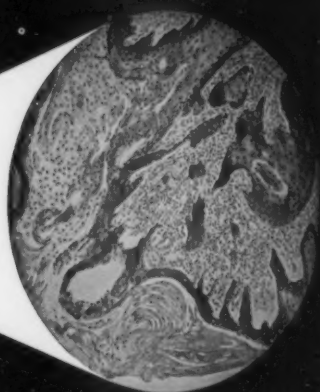


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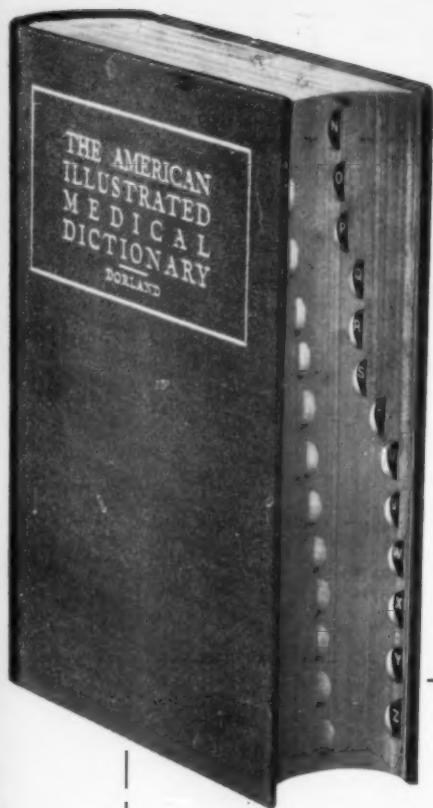


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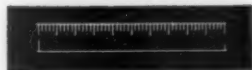
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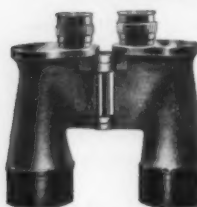
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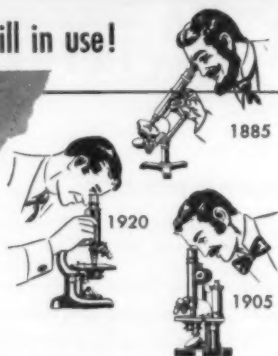


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Manpower for Research and Development¹

Ralph M. Hogan

Manpower Branch, Human Resources Division, Office of Naval Research, Washington, D. C.

AS GOVERNMENTS become more and more involved in research and development and as the leadership of a nation depends more on its scientific and technical personnel, it becomes increasingly important that some basic rosters and evaluations be made on the proper handling of specialized manpower. Whatever the scientific problem, manpower is one key to its solution. The several studies now being carried on under contract through the Manpower Branch, Human Resources Division of the Office of Naval Research, should give facts that will enable the research administrators to plan and administer a broad and comprehensive research and development program for national defense and for the nation's progress.

SOURCE FILES

During World War II, those responsible for the national defense found it difficult to locate and utilize efficiently the nation's supply of trained research and development workers. In order to meet their responsibility, the National Defense Services have undertaken an inventory of the highly specialized research and development scientists and engineers who are guiding and carrying on the research activities in universities, institutions, industry, and government. It is felt that this inventory will not only serve as a source file of qualified and highly selected workers, but will also supply the basic data for such studies as they are needed for the planning of research, the most effective utilization of available trained manpower, and the administration of research, particularly that directly concerned with national defense.

Although this program of research on specialized manpower is being carried on under the administration of ONR, it is, in the main, a joint program of the Army, Navy, and Air Force. Each service has designated a representative who, as one of a "sponsors" group, has given assistance in planning and securing financial aid. This group has given direction to the several rosters or source files being compiled in this phase of the manpower program.

¹ Based on an article in the *Monthly Research Report* of the Office of Naval Research, November 1, 1949.

Other interested government agencies have joined in the planning for these projects. Representatives from such agencies as the Research and Development Board, the National Security Resources Board, the Munitions Board, the Atomic Energy Commission, the Bureau of Labor Statistics, the Census Bureau, the U. S. Employment Service, and the Bureau of the Budget have met with the sponsors' group to discuss, and to be informed of, the progress of the several projects.

In addition, organizations representing the various professional societies with which most of the professional workers are affiliated, and the schools and colleges from which most of the professional workers come, have been solicited for aid and guidance during the progress of the program. In fact, three of these, the National Research Council, the American Council on Education, and the Engineers Joint Council have appointed committees to assist in the program and have undertaken contracts on specific projects. As joint projects, these are excellent examples of cooperation within the Department of Defense, among government agencies concerned, and with the national professional societies.

The first projects undertaken under this program, and those with which I shall primarily deal, are the compilation of a number of rosters or source files of key physical scientists and engineers who have had experience in research and development work or who are potential workers because of their intensive or specialized training in one or more occupational specialties.

Plans were made to compile a file of key research and development physical scientists and of highly specialized research and development engineers, and to make an inventory of all the scientists and engineers, at whatever level, working on research and development problems in any service of the Department of Defense. The two source files are not employment registers for use of the military services or other government agencies, but primarily are for the purpose of having complete information available for any and all problems of research and development manpower that may arise in connection with the scientific program of the national defense. For ex-

ample, the statement has been made that there are more funds than there are qualified workers available for the research now planned. The rosters should prove of value for effectively allotting this money.

NATIONAL ROSTER

Upon the undertaking of the two source file projects, the question was raised as to whether the existing National Roster, or at least its files, could be utilized. Examination revealed that the files were no longer in working order, having been stored without an active custodian. In addition, no data had been collected for a number of years; thus, the files lacked the very important records of World War II experience of the scientists and engineers who would be most valuable in the immediate future. It was felt, too, that the "population" represented in the National Roster was general rather than highly specialized in research and development. This has been confirmed; only 17.0 percent of the National Roster physical scientists have the Ph.D., whereas 75.6 percent of these in the source file have that degree. Furthermore, the median age of the roster respondents was at least ten years less than the median age of 46.1 years for the source file, after making allowance for the period in which the information was gathered. An intensive examination of the engineer registrants of the National Roster revealed similar facts. Thus, the conclusion was reached that it would be both more efficient and economical to make a fresh start.

Although the two source files (Physical Scientists and Engineers) are both supplementary and complementary, and are in fact one file as far as the needs of national defense are concerned, the nature of American education and the professional organizations made it imperative to plan and execute the two projects separately. As already implied, the cooperation of the professional societies is most necessary in compiling the source files.

INFORMATION SOUGHT

In the case of the Physical Scientist Source File, the Office of Naval Research turned to the National Research Council of the National Academy of Sciences to undertake the contract for securing the necessary data. The NRC assigned responsibility for this task to its Office of Scientific Personnel. In attempting to select the respondents for such a source file, it was decided to make use of the basic list of such scientists in the publication *American Men of Science*, which has compiled such listings in the past forty years, and which is recognized as an authoritative guide to the leaders in science. The membership lists of the various professional societies do not, as a rule, give any guide as to scientists who should or should

not be included in the category of research and development workers. It was felt, however, that major attention should be given to the basic list, namely those younger physical scientists who have been engaged in research and development in the extensive research program of World War II, or who are potential research and development workers. The Office of Scientific Personnel therefore secured the names and addresses of all men granted the Ph.D. in physical science since 1936. This date was set on the assumption that any scientist granted the Ph.D. in 1935 or prior would have been listed in the latest edition (1943) of *American Men of Science*.

It was found that Science Press was planning the issue of a new edition, the eighth, of *American Men of Science*. In order to conserve the time and energy of the respondents, use is being made of the AMS basic list. For financial economy, the NRC entered into a contract, upon approval of the Office of Naval Research, for the AMS to secure the data needed for the source file along with the data needed for their publication. The compilation of the data is practically complete.

Following meetings with representatives of a number of engineering societies, the Engineers Joint Council (composed of the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers) was approached for guidance in the conduct of the task, particularly in making up a list of respondents to be circularized. Here no accepted or authoritative guide, such as *American Men of Science*, was available. It was therefore decided that it would be necessary to list all the full professional members of the some eighteen major national professional organizations of engineers. From such a listing a selection would be made of those respondents to be included in the Research and Development Engineers Source File on the basis of academic training, experience, and function as revealed in the questionnaires. It should be noted here that there are two engineers to each physical scientist in research and development.

Under the sponsorship of the Engineers Joint Council, the American Society of Mechanical Engineers entered into contract with the Office of Naval Research to compile a master list of the professional engineers represented in the eighteen cooperating societies:

American Institute of Chemical Engineers
American Institute of Electrical Engineers
American Institute of Mining and Metallurgical Engineers
American Society of Civil Engineers

American Society of Heating and Ventilating Engineers
 The American Society of Mechanical Engineers
 American Society for Metals
 American Society of Refrigerating Engineers
 Electrochemical Society
 Institute of Aeronautical Sciences
 Institute of Ceramic Engineers
 Illuminating Engineering Society
 Institute of Radio Engineers
 National Society of Professional Engineers
 Society of Automotive Engineers
 Society of Economic Geologists
 Society of Exploration Geophysicists
 Society of Naval Architects and Marine Engineers

This yielded, without duplicates, some 97,000 names.

In both the physical science and the engineer mailings, an "Other Names" slip was included to give opportunity for the respondents to "nominate" or indicate the names of such scientists or engineers as they might know who meet the qualifications sought but are not included in the basic lists. These other names have given approximately a 10 percent addition to the original list.

As plans for the two source files were being made and the work of gathering the needed data got under way, it became increasingly clear that the three services needed data on their own personnel engaged in research and development activities in a form comparable to the other rosters. This project is now under way, under the "chairmanship" of the Research and Development Board. Data are being sought from all professional workers in the three services, from P-1 level upward, thus differing from the two files where only the leaders or key workers are to be included. This then becomes an *inventory*, which is a guide to the needs of the services for personnel directly employed. But, as indicated earlier, in meeting problems of research and development for national defense, the military services and all government agencies know that they must depend on universities, research organizations, and industry to supply most of the research and development facilities, workers, and consultants. The data being gathered are needed by the military services for ascertaining what has been done, and for planning, guidance, and contracting for needed work.

DATA GATHERED

Concurrent with the planning for the two source file projects, several groups worked on the problem of determining what data should be gathered. In the case of the physical scientists, the original draft was prepared under the direction of the Office of Scientific Personnel for NRC, with later review by the

Sponsors' Committee. Additions were made to meet the AMS needs when it was decided to use Science Press as the agent for circularizing the questionnaire. Finally, when an acceptable draft had been prepared, it was submitted to the Division of Statistical Standards of the Bureau of the Budget for approval. That division gave assistance and guidance that were helpful, instead of merely dealing with the perfunctory clearance of the questionnaire.

The questionnaire for the Survey of Selected Engineering Personnel was prepared in the main by consultants from the engineering societies, with the assistance of the Bureau of the Budget. That for the Inventory of Research and Development Personnel in the three services was prepared by the Sponsors' Committee under the direction of the Research and Development Board.

In all three projects, essentially the same data have been sought. These include such items as:

1. Personal identifying data—name, age, residence
2. Academic training and specialization
3. Employment and experience record
4. Income (voluntary—some 80 percent returns)
5. Professional society participation
6. Government research—engaged indirectly or directly employed
7. Military service
8. Knowledge of foreign languages and foreign areas
9. Occupational specialty
10. Function—research, design, development, testing, procurement, production, construction, operation, administration, teaching

With the high degree of specialization in science and engineering, frequently without direct relationship to the basic academic training of the worker, it has become increasingly important to discover what are the occupational specialties of the research and development worker, and the functions best performed by the worker in that specialty. Therefore, for each of the projects, a very complete list of occupational specialties was prepared. The experience of the National Roster offered many suggestions along this line. For the physical scientists, some 612 occupational specialties were selected by an Ad Hoc Committee of the NRC; for the engineers, some 290 occupational specialties, by a group of consultants, with a review by the advisory committee of the Engineers Joint Council; and for the three services' inventory, some 590 occupational specialties by the Sponsors' Committee.

As a result of the work on the three lists, it seems that a next step should be that of the preparation of a Master List of Occupational Specialties. This, in turn, will lead to the preparation of a Dictionary of Occupational Specialties at the Scientific and Engi-

neering Level. No such authoritative work as the *Dictionary of Occupational Titles*, prepared by the U. S. Employment Service, and used in industry, is available for work at the professional level.

HANDLING THE DATA

Questionnaires have gone to some 50,000 physical scientists. After one year, approximately 90 percent have been returned. In the engineers' study, less than two months after the first mailing, over 30 percent returns have been received.

As the returns come in, the mailing file is checked and the respondent's card removed. After sixty days, follow-up post cards are sent to those who have not responded. The questionnaires are numbered in order of receipt and microfilmed in this serial order. Data are then transposed to transcription sheets by coders under the direction of the Occupational Outlook Branch of the Bureau of Labor Statistics, after which they are transferred to IBM punch cards. Most of the microfilming, IBM card-punching, and listing have been done within the various government agencies concerned. The original questionnaires are to be returned to ONR for custodianship.

Two listings are made through the use of the IBM cards: (1) an alphabetical listing of all respondents with serial number and certain other data (from which any respondent's questionnaire, either original or on the microfilm, can be located in the serial file); and (2) list of respondents by occupational specialties, each respondent being listed alphabetically under each of the three occupational specialties he indicated, with the list keyed as to the first, second, and third field, together with the functions and years of experience in that occupational specialty. With these two indexes, it is possible to locate a scientist or engineer by name, or to locate men with particular qualifications within any one of the several hundred occupational specialties. Through use of the IBM cards themselves, an individual or group of individuals with peculiar qualifications can be discovered—e.g., under 32, with World War II service, knowledge of China, etc.—within the limits of the data punched on the cards. Thus the data become a source file with immediate potential use and a necessary tool in case of an emergency.

The data derived in the compilation of the source files and intraservice inventory are no doubt the most complete so far available for study of the highly specialized professional and technical manpower resources of our nation. The Bureau of Labor Statistics, both on its own initiative and under contract with ONR, is carrying on a number of highly specialized studies, in addition to the gross statistics (based directly on the categories in the questionnaires, such

as age, education, earnings, military service, occupational placement, and specialties). Among the special studies under way are:

1. An intensive study of the mobility of selected scientists among the fields of specialization
2. Differences among educational institutions in the production of key scientists
3. Educational level among various occupational specialties
4. Type of employer and employment among various occupational specialties
5. Time lag between receiving bachelor's and doctor's degrees in various disciplines, and among various occupational specialties

Other groups will be making use of the data. For example, at present the Naval Research Council, through its Office of Scientific Personnel, is studying differentials among government, industry, and research institutions and universities. The Atomic Energy Commission, which contributed toward the coding of the physical scientist questionnaire, has made studies of the data applicable to its scientific and technical manpower problems.

When these studies were launched, it was contemplated that the future National Science Foundation would take over the custodianship of the files. The continued operation of the rosters would be its responsibility. If the inception of the source files had been delayed until the National Science Foundation is ready to undertake this responsibility, it was feared a two- or three-year delay might occur. This group of projects was intended to meet an immediate pressing need of the military services, but with the idea that the National Science Foundation in due time could take over the operation and maintenance. With one source file completed and the second nearing completion, and still no National Science Foundation, the question of efficient operation and maintenance is assuming crucial importance. This is now being discussed with the three services; the Bureau of the Budget and other government agencies are being solicited for suggestions.²

RELATED PROJECTS

This account has dealt with the three listings of research and development personnel—scientists, engineers, and Department of Defense workers. However, the Manpower Branch has several other projects under way, or in the planning stage, which are basic for the analysis of supply and demand of research and development manpower. Among these are:

² Pending the organization of the recently created National Science Foundation, the National Security Resources Board is establishing a unit in the Office of Education to maintain and operate the two source files.

a) *Scientist resources*: A study of the current output of universities and colleges. The Office of Education, at the suggestion of the ONR, has been gathering annually, starting in 1948, information on the Bachelor's, Master's, and Doctor's majors in each school subject. This is the first time this information, necessary for analysis of the oncoming research and development workers, has been available. The American Society for Engineering Education has for a number of years secured and analyzed data concerning engineering school enrollment and graduation. This, too, at the suggestion of the ONR, is being taken over by the Office of Education in order that more detailed analyses will be available.

b) *Ph.D. list*: The basic list of recent Ph.D. graduates is also being maintained in still another project, which will supply detailed analyses of the data.

c) *Beginning scientists*: Pilot Study of Candidates Resulting from Potomac River Naval Command Board of U. S. Civil Service Examiners P-1 Examination for 1947 and 1948 indicates the type and quality of applicants and appointees resulting from the Navy's tapping the universities for the beginning scientific and engineering worker.

The projects listed in this article are but steps in a program for the assessment of the nation's manpower for research and development. The Manpower Branch plans to support projects in this area which will give a well-rounded description and evaluation of the supply and demand for such personnel, by universities, industry, research organizations, and government.



A Radiation Meter for Disaster Use

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UNTIL THE DEVELOPMENT OF ATOMIC ENERGY, the number of persons exposed to the harmful radiations from radioactive substances was very small. Most of those exposed were well aware of the hazards to life and health presented by such radiation, and could provide themselves with instruments enabling them to measure radiation intensity and avoid overexposure.

The large-scale development of atomic energy sources and the present emphasis in several countries on the production of increasingly powerful atomic weapons have, however, considerably changed this picture. Tremendous and altogether unprecedented quantities of dangerously radioactive substances can now be liberated in a single explosion, or manufactured in a nuclear energy plant and delivered in the form of radioactive poisons, producing radiation hazards of fantastic magnitude. Spectacular as are the immediate destructive effects of the explosion of a nuclear bomb, the aftereffects of the radiation and the contamination by radioactive elements bid fair to be even more decisive in future warfare. In the Hiroshima explosion, 15-20 percent of the casualties resulted from radiation damage inflicted at the instant

of detonation: It is estimated that all exposed persons within a radius of approximately half a mile received lethal or near-lethal doses of gamma radiation (2). Because the bomb was exploded high in the air, the residual radioactive contamination was negligible. In test Baker, at Bikini, the explosion took place under water, and the instantaneous radiation was largely absorbed. On the other hand, the resulting "base surge" of mist and spray caused a precipitation of radioactive materials estimated to be lethal over several square miles, and the lagoon, together with its plant and animal life, was dangerously contaminated for some months.

When one considers that only a few pounds of radioactive materials are produced in such a bomb and that perhaps some tons would be produced by the neutrons resulting from an H-bomb explosion, it does not seem unreasonable to expect that such an explosion, under suitable meteorological conditions, could render a large city so "hot," in the sense of producing a high level of radiation, that it could not be inhabited for years or even generations. Nor need such a catastrophe be accompanied by an explosion: Thirring has pointed out in a careful and conservative analysis (1)

that the by-product radioactive materials from a single nuclear power reactor of the size of the Hanford installation could be used to render a large city uninhabitable for an indefinite period. The active materials could be incorporated in a few hundred pounds of dust or sand and distributed from an airplane or from rockets launched from ships or submarines. About 60 percent of the reactor by-products have half-lives between a few days and a year: the effective life would be about a month. In a month's time a new supply could be produced by the reactor and used to maintain the contamination level if desired. Such a weapon has, from many points of view, considerable military advantage against an unprotected population, even over the much-publicized H-bomb. The target city would be completely undamaged and, after cessation of the periodic contaminations, could be taken over by the invading forces. These facts, together with the consideration that only waste products are used and no expensive energy-source materials are lost, suggest this as the most likely atomic weapon of a future attack on Western Europe and perhaps even on the United States.

An insidious feature of radioactive contamination, whether present as the aftermath of a nuclear explosion or as a primary weapon, is that the radiation is undetectable by the senses. A general body dose of the order of a few hundred roentgens, accumulated in a sufficiently short time, may produce no immediately visible effect but may, nevertheless, result in the death of the victim in a few days or weeks. Even at a much slower rate of a few tens of roentgens per day, grave damage may be done before identifiable physiological effects appear. In this respect, an overdose of radiation is analogous to sunburn, where the victim may receive a painful or dangerous burn without any effects being observable during the exposure period. In view of the impossibility of judging without instruments the extreme hazards to which large numbers of people will be exposed without warning in case of an attack, it is clear that there exists a need of quite a new order of magnitude for radiation meters suitable for evaluating these hazards.

The radiation-measuring instruments needed for the routine protection of those actually engaged in atomic energy work have received considerable attention and are available in relatively convenient form. These instruments are, for the most part, designed to deal with levels of radiation intensity in the general neighborhood of, or far below, the presently accepted "tolerance" magnitude;¹ they are therefore of relatively high sensitivity and accuracy. They are needed in

¹ The "tolerance" level, of the order of 0.05 roentgen units per day, is the maximum rate at which the human body can absorb radiation continuously without demonstrable cumulative effects.

rather small numbers, hence their cost is not a determining factor in design. They are used by people experienced in radiation measurement and therefore need not be especially rugged or simple. Such devices as the currently available ionization or counting-rate survey meters and pocket electroscopes or ionization chambers are typical of instruments in this class.

An entirely different problem is presented by the radiation instrumentation needed for citizens, rescue teams, and military personnel involved in an atomic disaster of the character discussed above. In such a case, one will have to deal with very high levels of radiation intensity, as compared with the "tolerance" level, and quick action in leaving a heavily contaminated area will be necessary to avert radiation illness or death. It is essential, however, to be sure that one is moving away from contaminated areas to areas where the radiation level is lower; this can scarcely be done except on a basis of continuous measurements of radiation intensity. Rescue activities must be conducted with some regard for the lives and safety of the rescue personnel. Only a measurement of radiation intensity can determine how long it is safe to stay in a given contaminated area without receiving a lethal dose or running an unreasonable risk. It will be imperative to determine, by some simple means, which living victims of an atomic disaster have received so large a dose of radiation that their death is inevitable, so that the limited rescue facilities can be concentrated on those victims who have some chance of survival. Recently the Atomic Energy Commission has announced the development of an identification tag that will indicate by change in color when a victim has received a lethal dose of radiation. This should fulfill a most important need if generally adopted, but such devices do not obviate the urgent need for a continuously indicating meter for use by less seriously affected victims and rescue personnel. The movement of combat troops through a contaminated area also requires a careful evaluation of radiation hazards, based upon radiation intensity measurements made at each point to be occupied.

Another important function of a radiation instrument under the circumstances envisaged is that of preventing mass hysteria and widespread panic. It does not require any imagination to see that the consequences of even a false alarm of a radioactive attack or of local contamination at some distance from a bomb blast could be disastrous in the absence of effective means that will enable each individual to ascertain for himself the true state of affairs. The very facts that radiation cannot be detected by ordinary means and that reaction is delayed make it possible to use the threat of radioactive attack as a most terrifying psychological weapon.

The properties of the radiation-measuring instruments needed for the purposes just described are quite different from the properties of existing instruments. Radiation meters for disaster use will be required in large numbers, hence they must be simple and cheap to make. They will be used by people unfamiliar with such techniques; therefore they must be extremely rugged, easy to use, and reliable both in what they indicate and in the ease of interpreting that indication. To serve their purpose adequately they should be as simple and common as flashlights, gas masks, or first aid kits, available to every rescue crew, civilian defense team, or squad of troops. Because many of the instruments in a bombed area will be out of commission, either from physical damage or neutron-induced radioactivity of the instruments themselves, emergency stores must be maintained for instant distribution from dispersed depots. In view of the uncertainty as to when and where such stores will be put into use, the maintenance required should be kept to a minimum. Even batteries, which require replacement once or twice a year, should be avoided.

The sensitivity of a radiation meter for disaster use need not be high. Indeed, a device which would give a measurable indication when a small percentage of a lethal dose, say 50 roentgens, had been received would cover most exigencies. On the other hand, it is preferable to have a means of estimating in a few seconds or minutes how long a contaminated area can safely be occupied. Even a dose of 50 roentgens may have deleterious effects and should be avoided if possible. With a more sensitive instrument, the degree of hazard can be estimated from the rate of discharge with negligible exposure of the user, and large areas can be rapidly surveyed in a short time. Operations in a contaminated area for hours or days ahead can be planned only if the radiation intensity is known long before dosages of dangerous magnitudes have accumulated. A sensitivity of the order of 0.1-1.0 roentgens full scale, which is easily attainable in a simple instrument, would appear to be a reasonable value, provided the instrument can be recharged at will. With a sensitivity of 1 roentgen, for example, a full-scale deflection in one minute would indicate the relatively high hazard of 60 roentgens per hour. An area where such a rate is observed should be immediately evacuated, and any entry into the area limited to as short a time as possible. On the other hand, if only 0.1 roentgen is indicated in one minute, operations can be executed at a more leisurely pace. The important point is that the information necessary to evaluate the hazard is immediately at hand and available to those most directly concerned.

The above discussion represents the personal views and opinions of the writers and may not conform with

the views of responsible authorities, particularly in the Department of Defense; but, as such views are closely guarded secrets, we can only use our own judgment. Also, it is conceivable that our armed forces have already developed satisfactory instruments for these important purposes, but, for reasons that are not clear, such information is not available to the public. We can only proceed on the assumption that no fully satisfactory instrument for this purpose has so far been developed.

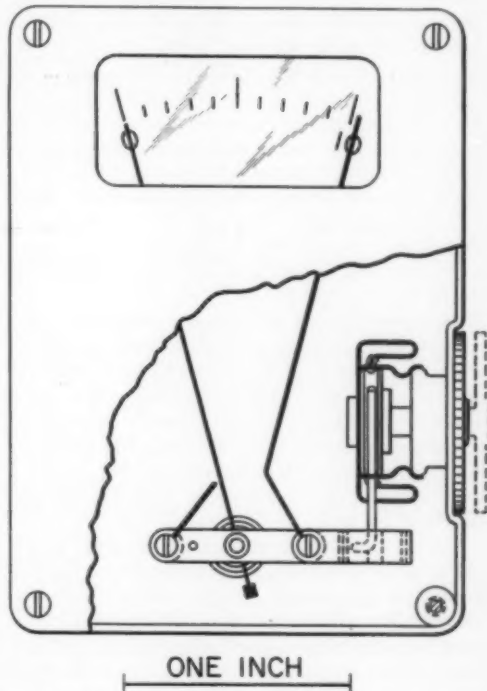


FIG. 1. Pocket-sized radiation meter with friction charging device.

One form of radiation meter that we believe to be suitable in its major features for disaster use is illustrated in Fig. 1. The instrument comprises essentially an electrostatic voltmeter of low capacity, mounted in a case that serves as an ionization chamber, and provided with a friction charging device. The voltmeter movement consists of a stiff, light aluminum needle, mounted in a simple pivot arrangement with a spiral restoring spring and repelled by a fixed arm at the same potential. The meter movement, including the repelling arm, is insulated from the case. A stop prevents accidental discharging by limiting the motion of the needle. With the dimensions shown, and a light hairspring, the sensitivity of

the voltmeter is about 500 volts for 20° deflection, and the moving system has a time constant of the order of a few tenths of a second. Because of the lightness of the needle, the pivot loading is negligible and jewels are unnecessary. For the same reason, the movement is quite rugged and will survive any shock which does not damage the case. Although the deflection of the needle is not accurately linear with voltage, the departure from linearity can be made small by proper design of the instrument, and it is an easy matter to calibrate the scale in roentgens. The radiation sensitivity can be adjusted over a wide range by varying the size of the case or the capacity of the meter, and over a smaller range by adjustment of the hairspring tension or the length of the repelling arm. As a general rule, the depth of the case should be somewhat greater than the maximum travel of the needle; otherwise electrostatic forces between the needle and case will cause low sensitivity near maximum deflection. The efficiency of ion collection is also enhanced by so designing the case that all walls are roughly equidistant from the high potential collecting surfaces.

Aside from the not too stringent conditions on the general design enumerated above, the size and shape of the case may be varied considerably to suit the convenience of the user. The model illustrated is about the size of a cigarette package and would appear to be a practical choice for a pocket instrument. Another version has been made in the form of a pillbox 1.5 inches in diameter and 0.5 inch thick, conveniently carried on the wrist.

An essential feature of these instruments is the provision for recharging. A practical solution of this problem is the friction charging device illustrated, which is of a type that has been used for similar purposes for many years. Static electricity is produced by turning a hard rubber, lucite, or polystyrene drum against a leather friction pad; a metal band around the drum collects the charge and acts as a switch. In operation, the thumb wheel outside the case is snapped outward and rotated. The combination of these two motions engages a tab connecting the collector band to the voltmeter; a further rotation of one or two turns charges the instrument. When charging is completed, the contact is disengaged by snapping the thumb wheel in against the case. The shaft may be sealed with an O-ring packing to prevent entrance of moisture.

The question of the materials used in the radiation

meter requires some consideration. For reliable indication of dosage, particularly of relatively soft x-rays, it is desirable that materials of low atomic number be used. If the instrument is likely to be exposed to any appreciable neutron flux, it must not contain materials which yield radioactive products of long half-life: iron, copper, and silver would be undesirable materials, whereas hydrogen, beryllium, carbon, oxygen, and aluminum would be quite suitable for the purpose.

Although some attempt has been made in the preceding discussion to indicate how a radiation meter might be used in an atomic disaster, it is clear that a complete solution to the problem of properly evaluating radiation hazards in such circumstances is a complicated matter. The exact character of the catastrophe will determine the type of radiation present. Thus, in the instant of detonation of a thermonuclear bomb, the principal radiation damage may be from neutrons: Here one will presumably estimate dosages received by measuring activities induced in various materials at the scene. After the blast, one will be confronted with a wide variety of problems of evaluation. The gamma radiation present is relatively easily measured, and its effects are relatively predictable; beta radiation can be fairly easily measured, for example, by means of a meter provided with a suitable window in the case, and its external effects are reasonably well known. Such materials as are breathed or otherwise gain entry into the human system present, on the other hand, quite considerable difficulties, particularly if they are long-lived, and if they enter into the body chemistry. Here even very small amounts of material can have effects entirely out of proportion to their activities as determined by a radiation meter. The identification of such substances will ordinarily require especially trained personnel and may involve analytical techniques not easily carried out in field operations. The particular case of plutonium contamination, as experienced in the Bikini tests, can be dealt with most simply, since the alpha particles can be detected readily if a very thin window is provided in the case of the instrument. Such a window will, of course, be vulnerable to damage from rough handling and may not be desirable for general use.

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Technical Papers

Cross Tolerances in Resistant Houseflies

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Strains of houseflies (*Musca domestica* L.) that have developed resistance to a given insecticidal chemical may or may not exhibit some resistance to other chemically unrelated insecticides. There are no reported instances of the specific resistance of *M. domestica* to an insecticide, but some strains do show cross tolerance only to analogues of the compound to which they have developed resistance (1, 5, 6). Other strains exhibit various degrees of cross tolerance for a few to several unrelated compounds (3, 4, 6-8). Barber and Schmitt (2) reported that a strain selected for resistance to methoxychlor was not resistant to DDT.

The work reported was undertaken to determine whether resistance could be developed in *M. domestica* toward several insecticidal compounds simultaneously. The research was carried on incidental to physiological studies of resistance, and the method used for evaluating resistance was not as accurate as more time-consuming ones would be. However, the results are thought to be of sufficient interest to report, in the hope that they may aid others working on the problem of resistance.

The two strains used in these experiments were derived from the 55th generation of a strain of *M. domestica* in which resistance to DDT was developed by Wilson and Gahan (8). Selection of the strain for resistance to DDT was continued in this laboratory for 20 generations, and adults of the 21st generation were tested for resistance to the individual components of an insecticidal mixture containing the following compounds dissolved in cyclohexanone: DDT, methoxychlor, chlordane, lindane, toxaphene, and pyrethrins (proportions as indicated in Table 3). Selection was accomplished by exposing the adults to sprays or deposits of DDT that would cause approximately 90% mortality. All exposures were done prior to mating so that offspring would derive only from parents that had survived exposure to DDT. This DDT-resistant strain is herein designated as strain R.

Selection for resistance to the mixture of insecticides was begun with adults of the 9th generation of strain R, and was accomplished as described except that the mixture of insecticides was used instead of DDT alone. Concentration of the mixture was adjusted so that approximately 90% of the adults of each generation were killed. Selection was carried out for 11 generations, and tests for resistance to the individual components of the in-

secticidal mixture were made with adults of the 12th generation. This strain is herein designated as strain RX. The normal laboratory strain, which was not selected for resistance or otherwise exposed to insecticides, is designated as strain N.

In the tests for resistance, flies were confined in wire cages suspended from the top of a 36-cu ft chamber, and the cages were continuously swung during exposure. One milliliter of the desired solution was sprayed into the chamber by means of a small atomizer, and the spray was allowed to settle for 20 sec. The flies were then introduced and exposed for 2 min. They were then transferred to clean cages, supplied with food, and held at a temperature of approximately 27° C and 60% relative

TABLE 1
MORTALITIES IN SUCCESSIVE GENERATIONS OF HOUSEFLY
STRAINS N AND R EXPOSED TO DDT SPRAY

Strain N		Strain R	
Generation	Percent mortality	Generation	Percent mortality
2% DDT			
A	92	13	33
B	84	14	41
C	83	15	25
D	83	16	2
E	87	17	5
F	74	18	3 (RX ₁₈ = 2%)
4% DDT			
G	97	19	2 (RX ₁₉ = 3%)
H	90	20	0.2
I	91	21	0

humidity for 24 hr, at the end of which period mortality counts were taken. Single tests were made using 200-600 flies 24-32 hr old, all three strains being sprayed simultaneously.

Table 1 shows that strain R developed increasing resistance to DDT during the period of selection for resistance to this insecticide. Table 2 indicates a simultaneous increase in resistance of strain R to the insecticide mixture.

An increase in the resistance of strain RX to the insecticide mixture during the period of selection is apparent in Table 2. Further evidence that strain RX developed resistance to the mixture may be seen in the fact that the concentration of the mixture required to kill approximately 90% of the adults of generation 11 was 12 times that required to kill approximately 90% of the adults of generation 1.

The results of comparing the susceptibilities of strains N, R, and RX to the individual components of the insecticide mixture are presented in Table 3. Strains R and RX are more resistant than strain N to all the com-

TABLE 2
MORTALITIES IN SUCCESSIVE GENERATIONS OF HOUSEFLY
STRAINS N, R, AND RX SPRAYED WITH A SOLUTION
CONTAINING DDT, METHOXYCHLOR, CHLORDANE,
LINDANE, TOXAPHENE, AND PYRETHRINS*

Strain N		Strain R		Strain RX	
Genera- tion	Per- cent mor- tality	Genera- tion	Per- cent mor- tality	Genera- tion	Per- cent mor- tality
C	99	15	76	6	65
D	90	16	..	7	40
E	95	17	18	8	23
F	96	18	7	9	6
G	96	19	..	10	8
H	96	20	0	11	..
I	98	21	12	12	17

* Proportions as indicated in Table 3.

pounds. Strain RX shows no greater resistance than strain R to the mixture or to its components. It is also apparent (Tables 1 and 3) that strains R and RX show a similar degree of resistance to DDT, although the latter strain was not selected for resistance to DDT alone. Strain RX was tested for resistance to parathion and, on an LD₅₀ basis, was found to be twice as resistant as strain N.

It appears, then, that strains R and RX show no specific resistance to the compounds for which they were selected, but rather show some degree of resistance to other compounds. Another point of interest is that the resistance of strains R and RX is practically the same for all of the six compounds tested. If resistance were strictly specific, strain R should be considerably more resistant to DDT than strain RX, and strain RX should be more resistant than strain R to the components of the insecticide mixture other than DDT and methoxychlor.

The question arises whether a portion of this general resistance may be due to increased vigor of the flies, resulting from several generations of selection for ability to withstand adverse conditions, i.e., poisoning by a toxic substance. Wilson and Gahan (8) concluded that their DDT-resistant laboratory strain was an unusually strong stock of flies, since the resistance was not specific for

TABLE 3
MORTALITIES OF STRAINS N, R, AND RX WHEN SPRAYED
WITH THE INDIVIDUAL COMPONENTS OF A
MIXTURE OF INSECTICIDES

Insecticide	Quantity sprayed (g/1,000 cu ft)	Strain and percent mortality		
		N	R	RX
DDT	5.555	99	0.3	1
Methoxychlor	2.222	97	4	1
Chlordane	0.556	98	8	7
Lindane	0.167	100	72	61
Toxaphene	0.556	100	69	68
Pyrethrins	5.555	70	3	1
Mixture	Each com- ponent in above quantity	100	99	91

DDT but extended to several other insecticides. March and Metcalf (7), after studying three resistant wild strains and one resistant laboratory strain, concluded that the levels of resistance of each strain were specific for different insecticides and not general for all the insecticides tested. It is obvious that if a general level of resistance to several insecticides existed, all the resistance would probably be due to an increased vigor of the strain, rather than to the development of some protective mechanism against a specific poison. In strains that exhibit cross tolerance for several compounds, it may be that all of the resistance exhibited to chemicals other than the one for which the strain was selected is due to increased vigor and not to the functioning of a protective mechanism.

Experiments are being planned to determine to what extent, if any, increased vigor functions in the cross tolerances of resistant houseflies to other insecticides and in the selection for resistance to a given insecticide.

It is interesting to note that all strains showing cross tolerance only to analogues of the insecticide to which resistance was developed are wild strains (1, 5, 6) which obviously are not selected for resistance so severely, or interbred so strongly, as are laboratory strains. Resistance of a strain of *M. domestica* to several unrelated compounds seems to be related to a high level of resistance to the compound for which the strain was selected.

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A Semiautomatic Injection Apparatus for Use with Radioactive Solutions¹

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In connection with the handling of highly radioactive or other dangerous materials, it is sometimes desirable to inject solutions into test animals by remote control. The apparatus described here affords a means of holding the skin of the animal in position while a hypodermic needle is automatically inserted. The apparatus is suitable for use with remote-control devices, and it has the

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FIG. 1. Semiautomatic injection apparatus.

advantage that preliminary anesthetization or complete immobilization of the animal is not essential.

The apparatus illustrated in Fig. 1 was developed and tested in this laboratory. It consists of a glass tube with side arm, attached to a syringe. A perforated glass disk was sealed at a distance of $\frac{1}{4}$ in. from the end of the tube. A 26-gage, 1-in. hypodermic needle was attached to the syringe. The tube and syringe were connected by means of a ground-glass joint so that the end of the hypodermic needle extended out through the perforated disk. A screw connection in the position of the ground-glass joint could be substituted as a means of varying the length of projection of the needle.

In operation, the syringe is filled with the solution to be injected; it is then attached to the tube with a suitable length ($\frac{1}{4}$ in. was used in our experiments) of the hypodermic needle extending through the perforated disk into the open end of the tube. The open end of the tube is placed against the skin of the animal to be injected, and suction is applied by attaching the side arm of the tube to a water aspirator. The plunger of the syringe should be held in place during this time. The skin is sucked back against the perforated disk and the needle is thus automatically forced through the skin. The injection is then made subcutaneously by simply pushing the plunger in; then the suction is immediately

released and the apparatus withdrawn.

Preliminary tests were made on the shaved belly of the rat. The apparatus was found to work very successfully if a sharp needle of the proper size is used. By connecting a suitable extension rod to the plunger of the syringe, injections could be made at considerable distances from the test animal. With slight modification (proper adjustment of the length of needle extending through the disk) intraperitoneal injections were possible.

The Informational Capacity of the Human Ear

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New concepts of the nature and measure of information (1, 4) have made it possible to specify quantitatively the informational capacity of the human ear. A published estimate (5) gives 330,000 as the approximate total number of monaurally distinguishable tones of all frequencies and intensities. Dividing this figure by $\frac{1}{4}$ sec, the approximate average time necessary for the discriminations measured, 1.3×10^6 is arrived at as the total number of distinguishable tone choices the ear can make in a second. The same figure can be obtained by an independent calculation. An extrapolation of Gabor's data (1) on the efficiency of perception of "logons," or elementary signals, up to 16 kc gives an average of 18% of the total, or 5,800, as the number perceptible in 1 sec. Using the Riesz intensity discrimination data (3), a weighted average of 230 j.n.d.'s (just noticeable differences) of intensity for pure tones can be obtained, over the whole frequency range. If it is assumed that the number is the same for an individual logon, a total of $230 \times 5,800 = 1.3 \times 10^6$ distinguishable tones/sec is calculated, in complete agreement with the figure estimated by the first method.

To express the capacity of the ear in the conventional informational units of "bits" (binary digits)/sec, it is necessary to inquire how many of the distinguishable tones are independent of each other. A crude procedure is to assume that neighboring logons can be independently perceived. The total number of bits/sec will then be the product of 5,800, the number of logons/sec, by the average number of bits/logon. The latter figure is calculated from the Riesz data (3) to be 8.2, by taking the weighted average of the \log_2 of the number of intensity j.n.d.'s at each frequency. By this procedure, about 50,000 bits/sec is the estimated informational capacity of the ear.

Since neighboring frequencies are known to mask one another, this figure is certainly high. Wever's recent critical review (7) presents convincing evidence that the masking is due both to peripheral and central interference phenomena. However, calculation of the effect of mask-

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ing will be performed under the arbitrary assumption that it is due strictly to stimulation of a broad region on the basilar membrane, in accordance with a "place" theory of hearing. The calculated informational capacity depends only on the masking and intensity data, and is independent of which auditory mechanism is used.

On this basis, response of the ear at any time can be described by the "stimulation profile," a graph of stimulus intensity vs. position on the basilar membrane. It represents a sort of short period Fourier analysis of the sound along the membrane. The effect of the phenomenon which leads to masking of adjacent frequencies can be represented by stating that the derivative of the profile cannot exceed a certain value. Thus intense sounds "swallow up" faint ones at neighboring frequencies, because stimulus intensity decays insufficiently with frequency to allow the weak tone to be perceived.

At any point in the hearing region, a certain length along the basilar membrane will have to be traversed before a single intensity j.n.d. can be perceived. This can be called the masking distance, and is larger for low tones than for high ones, in general. With simplifying assumptions, the total number of distinguishable configurations possible to the stimulus profile can be counted. Using the Riesz intensity perception data (3), and averaging with the Wegel and Lane masking data (6), a length of about 0.04 mm on the basilar membrane is obtained as the average masking distance.

Any of three relations may be observed between two points separated by this distance on the profile. The point at higher frequency may be (1) the same intensity, (2) one j.n.d. more intense, or (3) one j.n.d. less intense than the lower frequency point. A simple calculation gives approximately $230 \times 3^{(230/0.4)}$ as the total possible number of profiles, since there are 230 j.n.d.'s in the average intensity range, three choices of profile direction in one masking distance, and 32/0.4 or 800 masking distances along the total basilar membrane. Hence, the total number of bits per profile is $\log_2 (230 \times 3^{(230/0.4)})$, or about 1,300 bits. Dividing by $\frac{1}{6}$ sec, the time required for the intensity discrimination measurements, a figure of about 8,000 bits/sec is obtained for the informational capacity of one human ear.

Two assumptions cause this figure to be crude. First, it is likely that the use of intensity measurements of shorter duration than $\frac{1}{6}$ sec would increase this figure, by allowing more profiles per sec to be possible, even though the amount of information per profile would decrease somewhat. Second, the use of a single averaged masking distance is subject to some error. Phase information, generally of no value except to binaural phenomena, is also neglected.

An important observation is that the dynamic range of the ear scarcely affects the final calculations. Only when the intensity range of the intelligence is cut down to 10 or 20 db is a sufficient fraction of the possible profiles ruled out to lower appreciably the informational capacity.

Since about 29,000 ganglion cells (8) are to be found in a cochlear nerve, we observe about 0.3 bit/sec of in-

formation per nerve fiber. This low figure naturally results from the lack of coding in the cochlear innervation. If the capacity is taken as 1.3×10^6 distinguishable tones/sec, then about 40 tones/sec can be accounted for by each fiber. This is about 10% of the maximum number of impulses which an adapted nerve fiber can carry.

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The Effect of Aureomycin on *Endamoeba histolytica* in Vitro

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Antibiotics obtained from molds or bacteria have shown thus far a very limited range of usefulness in diseases caused by protozoan parasites, with the exception of amebiasis. Good clinical results have been obtained in human infections with *Endamoeba histolytica* by the administration of penicillin (1), bacitracin (6), and aureomycin (5, 6), although it is inferred by some that improvement is due to the action of the antibiotics upon secondary bacterial invaders rather than directly on the amebas (4, 6). In the case of penicillin this seems to be substantiated by results obtained *in vitro*, in that no direct effect upon amebas was observed with levels as high as 30 Oxford units per ml for 48 hr (4). Gramicidin and subtilin were reported to be effective *in vitro*, and it was stated that subtilin lowers surface tension, causing rupture of the membrane of *E. histolytica* (2). In the course of a screening program *in vitro* for amebicidal substances in our laboratories, it was found necessary to evaluate the effects of antibiotics by a somewhat different procedure from that commonly used, in order to separate effects produced on amebas from bactericidal action against associated bacterial flora. These studies revealed that aureomycin produces what appears to be a direct effect on trophozoites of the strain of *E. histolytica* used.

The strain of *E. histolytica* used in this study was obtained through the courtesy of Charles Rees of the National Institutes of Health. It was designated as the NRSta strain, and when first received was growing in association with a single species of bacterium. Since a mixed bacterial flora gave more profuse growth, however, the culture was eventually maintained with a mixed unidentified bacterial flora for bioassays. Liver infusion agar (Difco) was used as a substrate, with either a Loeffler's Ringer's or horse serum-saline overlay and a

TABLE 1
EFFECT OF AUREOMYCIN HCL AND EMETINE HCL ON *Endamoeba histolytica* IN VITRO,
USING ASSAY METHOD NO. 1

Dilution	Aureomycin HCl								Emetine HCl		
	Assay No.								Assay No.		
	1	2	3	4	5	6	7	8	1	2	3
	Tube 1	Tube 2	Tube 3	Tube 1	Tube 2	Tube 1	Tube 2		Tube 1	Tube 2	Tube 3
1:100	0				0	0	0	0			
1:1,000	+					0	0	0			
1:5,000	+					0	0	0			
1:10,000	+	0	+	+	0	0	0	0	0	0	0
1:20,000		+	+	+					0	0	+
1:30,000		+	+	+					+	+	+
1:40,000		+	+	+					+	+	+
1:50,000	+	0	+	0	+	+	0	0	+	+	+++
1:60,000		+	+	+					+	++	++
1:70,000		+	+	+					+	++	+++
1:80,000		0	0	+					+	0	+
1:90,000									+	+++	+
1:100,000	+++	0	+	0	++	+	0	+	+++	+++	++
1:1,000,000 ...	+++					++	++	+++			

Controls—+, ++, or +++ throughout.

0 = No amebas found.

+ = Scanty growth of amebas.

++, +++, +++ = Moderate to heavy growth of amebas.

small quantity of rice starch. The Loeffler's-Ringer's overlay was prepared by dissolving 250 mg of Loeffler's dehydrated blood serum in 1,000 ml of sterile Ringer's solution. The horse serum-saline overlay was a mixture of 1 part fresh sterile horse serum in 7 parts of 0.85% sterile NaCl solution. Subcultures were made at intervals of 48 hr. Two methods were used for bioassay:

Method 1—Substances for test were dissolved in the overlay at varying dilutions, and subcultures of amebas were made to liver infusion agar slants covered with the test mixture. Usually, duplicate or triplicate tubes of various dilutions of the test mixture were inoculated. Approximately 0.1 ml of inoculum containing many motile amebas, rice starch, and bacteria from a 48-hr culture was used for each subculture. Incubation was carried out at 37.5° C for 48 hr, and the cultures were examined microscopically at the end of this period. Activity was expressed as shown in the accompanying tables. Since this method does not eliminate effects produced against the associated bacterial flora, any clearing of bacteria produced in the cultures was noted at the end of the 48-hr period, particularly if amebas were scarce or absent.

Method 2—Overlay containing many motile amebas, rice starch, and bacteria was pooled from 48-hr cultures, and 2 ml of this pooled material was incubated in 8 ml of physiological saline to which the substance to be tested had been added. At the end of the exposure time (10-60 min), the mixture was centrifuged at 2,000 rpm for 3 min, decanted, and washed with physiological saline. Additional centrifugation and washing were carried out three or four times. After the last wash and centrifugation, the sediment, containing amebas and granules of rice starch present in the original overlay,

was introduced into culture media which had been seeded with the mixed bacterial flora used routinely in subcultures. Amebas for control subcultures were treated in exactly the same way with physiological saline to which no test substance had been added. Growth of amebas was then recorded at the end of 48-hr incubation. There is, of course, the possibility that small amounts of test substances might be retained by the amebas during centrifugation and washing, or could be adsorbed on the granules of rice starch present in the pooled overlay. However, in every case in which this method was used, bacterial growth was as profuse in bacterial-seeded cultures inoculated with treated amebas as in controls, suggesting that very little of the test substance was carried over into the subcultures.

Table 1 presents data on the effects of aureomycin HCl and emetine HCl in varying dilutions and in different assays on the NRSt strain of *E. histolytica*, using assay Method 1. Growth of amebas was scarce or prevented completely in dilutions of aureomycin as high as 1:100,000 in some assays. Variations occurred in different assays, but these were not as great as those exhibited in dilutions of emetine beyond 1:40,000. Bacterial growth was considerably inhibited in higher dilutions of aureomycin, and a complete clearing of bacteria was observed in low dilutions, whereas bacterial growth in emetine dilutions, as determined by turbidity, was the same throughout. The fact that bacterial growth was inhibited or prevented completely in cultures containing aureomycin makes it difficult to determine whether a direct effect was produced on the amebas when this assay method was used.

The data given in Table 2, using assay method No. 2, demonstrate that a very pronounced effect against the amebas was produced by aureomycin in a dilution of 1:1,000, with from 10- to 60-min contact. Less pronounced effects were produced by dilutions of 1:10,000,

TABLE 2
EFFECT OF AUREOMYCIN HCL AND EMETINE HCL ON *Endamoeba histolytica* in Vitro,
USING ASSAY METHOD NO. 2*

Compound	Dilution	Growth on liver infusion agar in 48 hr								
		After 10-min contact			After 30-min contact			After 60-min contact		
		Tube 1	Tube 2	Tube 3	Tube 1	Tube 2	Tube 3	Tube 1	Tube 2	Tube 3
Aureomycin HCl	1:1,000	0	0	0	0	0	0	0	0	0
"	1:10,000	++	+	++	+	+	+	0	+	0
"	1:100,000	+	++	+	++	+	++	++	+++	+
Controls	(physiological saline)	+++	++	+++	+++	+++	++	+++	++	++
Aureomycin HCl	1:1,000							0	0	0
Emetine HCl	1:1,000							+++	+++	+++
Controls	(physiological saline)							+++	+++	+++
Aureomycin HCl	1:1,000							+	+	+
"	1:10,000							++	++	++
"	1:100,000							++	+++	+++
Emetine HCl	1:1,000							+++	+++	+++
"	1:10,000							+++	+++	+++
"	1:100,000							+++	+++	+++
Controls	(physiological saline)							+++	+++	+++

* Density of growth recorded as in Table 1.

although in the first assay listed the effect at this dilution was measurably greater after 60-min contact than after 10-min contact. Emetine, on the other hand, showed no evidence of direct amebicidal action after contact periods of 60 min at dilutions of 1:1,000.

The effect of aureomycin in dilutions of 1:1,000 at different pH ranges is shown in Table 3, using assay method No. 2. No measurable difference occurred in the effects produced within the pH range used.

TABLE 3
EFFECT OF AUREOMYCIN HCL AT DIFFERENT PH RANGES
ON *Endamoeba histolytica* IN VITRO, USING
ASSAY METHOD NO. 2

Compound	pH			Growth on liver infusion agar 48 hr after contact	
	Contact solution	Supernatant after first centrifugation	Overlay of liver infusion agar	Tube 1	Tube 2
Aureomycin HCl*	3.12	5.29	6.69	0	0
"	6.85	6.51	6.69	0	0
"	8.00	6.73	6.69	0	0
Controls (physiological saline)	6.41	6.70	6.69	++	+++

* In 1:1,000 dilution. Contact period was 60 min for aureomycin and controls.

Although evidence of the direct effect *in vitro* of aureomycin against *E. histolytica* obtained in these studies does not signify that a similar mode of action is involved in the disappearance of trophozoites in human infections treated with aureomycin, this possibility must

be considered. Similar assays *in vitro* have been conducted using streptomycin, bacitracin, and chloramphenicol, and none of these antibiotics in 1:1,000 dilutions have shown measurable direct effects upon *E. histolytica* when left in contact with motile amebas for 60 min. Neither emetine HCl nor chiniofon in dilutions of 1:1,000 killed the amebas during this period of contact.

It has been stated previously that little activity has been demonstrated *in vivo* by antibiotics against protozoan parasites. Tyrothricin (7) and clavacin (3) show antimalarial activity in birds, but the dosage is close to the toxic level. We have found aureomycin to be effective against *Plasmodium lophurae* Coggeshall in ducks, using intravenous doses of from 25 to 100 mg/kg twice daily for seven doses. All of the plasmodia are not removed within this dosage range, but reductions as great as 90% (at a dosage of 100 mg/kg), with pronounced degenerative changes in all stages of the asexual cycle, were noted. Streptomycin, bacitracin, or penicillin produced no measurable effects against *Plasmodium lophurae* within this dosage range. A direct analogy cannot be drawn between the antimalarial effect of aureomycin *in vivo* and its activity either *in vivo* or *in vitro* against *E. histolytica*. It is again apparent, however, that attempted explanations for the mode of action of aureomycin in clinical amebiasis must include the possibility that the amebas, as well as the intestinal flora, may be affected *in vivo*, since this antibiotic does possess protozoacidal properties.

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Precipitation of Menstrual Bleeding in Monkeys by a Folic Acid Antagonist¹

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Failure of estrogens to induce growth of the female reproductive tract in the absence of folic acid was first described for the chick (4). Similar results have been obtained with the frog (5), the rat (5), and the monkey (5). In 1948, Hertz (5) reported that six out of eight sexually immature monkeys on a folic acid-free diet failed to show cornification of the vaginal mucosa, development of the external genitalia, or growth of the sex skin after treatment with estradiol benzoate. Data presented in this report show that maintenance of the uterine endometrium of monkeys by estradiol³ is also affected by a lack of folic acid.

Five castrated female monkeys (*Macaca mulatta*) were injected subcutaneously with 10 μ g of estradiol daily throughout the experiment. This dosage of estrogen is sufficient to maintain the endometrium indefinitely without bleeding. After 20 days' pretreatment with estradiol, the monkeys were given daily injections of a folic acid antagonist, aminopterin,⁴ along with the estrogen. The susceptibility of monkeys to a lack of folic acid and individual differences of tolerance to aminopterin made it advisable to start the treatment with a low dose of the antagonist and to increase the amount, about every 10 days, until the animals menstruated or were prostrate due to the vitamin deficiency. This schedule was adhered to for all the animals, with two exceptions. Monkey 181 was kept on 100 μ g of aminopterin throughout the experiment, and monkey 175 was continued on 500 μ g of aminopterin when that level was reached (Table 1).

All monkeys were examined daily for menstrual bleeding, and blood counts were made at frequent intervals. Complete post-mortem examinations were performed on the animals when menstruation was noted or when the animals were in a state of collapse and near death.

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³ Estradiol was obtained through the courtesy of Schering Corporation, Bloomfield, New Jersey.

⁴ Aminopterin (4-aminopteroylglutamic acid) was obtained through the courtesy of Dr. E. L. R. Stokstad, Lederle Laboratories, Pearl River, New York.

Menstruation occurred in three of the five monkeys treated with estradiol and aminopterin (Table 1). These animals had received the antagonist for a total of 23-48 days, while the two monkeys that failed to menstruate had been under treatment for 22 days. It is apparent that neither length of treatment nor amount of antagonist given can explain the failure to produce menstruation in these two monkeys. A possible explanation may be found in the extreme variability in length of time required to produce a folic acid deficiency in monkeys (1), and the difficulty in keeping them alive once the deficient state is attained. Apparently, in order to produce menstruation in monkeys during estrogen treatment, it is not only necessary to produce a folic acid-deficient condition, but it is also necessary to keep the animals alive long enough for menstruation to occur.

TABLE 1
PRECIPITATION OF MENSTRUATION BY AMINOPTERIN IN MONKEYS UNDER DAILY TREATMENT WITH ESTRADIOL*

Monkey No.	Body wt. in kg	Days of treatment with aminopterin				Total No. days of treatment	Results
		100 μ g	200 μ g	500 μ g	1 mg		
169	4.52	10	10	9	9	38	Menstruation
175	3.36	10	10	28	—	48	Menstruation
179	3.77	10	10	2	—	22	No menstruation
180	3.09	10	12	—	—	22	No menstruation
181	3.52	23	—	—	—	23	Menstruation

* Castrated monkeys under daily treatment with 10 μ g of estradiol alone for several months to a year failed to menstruate during the course of treatment.

Previous work in this laboratory has shown that the daily dose of estradiol used in these experiments will induce maximal growth of the endometrium in monkeys within 20-30 days, and that menstruation does not occur when such treatment is continued for several months. Therefore, our results indicate that in the absence of folic acid, estrogen cannot maintain the uterine endometrium or prevent menstrual bleeding.

Menstruation failed to occur in three castrated monkeys that were first given 10 μ g of estradiol for 20 days and continued on daily injections of 10 μ g of estradiol, 2 mg of progesterone and aminopterin. Also, three castrated animals given 2 mg of progesterone and aminopterin daily, following a 20-day pretreatment with estrogen, did not menstruate. Thus it would appear that estrogen and progesterone act through different metabolic systems and only estrogen is inhibited sufficiently to precipitate menstruation.

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Fat Deposits in the Kidney in Chronic Intoxication of the Dog by Hexachlorocyclohexane

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We have found that chronic intoxication of dogs by the γ isomer of hexachlorocyclohexane (HCH) results in abnormal intracellular deposits of fat in most tissues and organs. This intoxication was obtained by repeated intramuscular injections of 10–30 mg of γ HCH in 10% oily solution per 1000 g of body weight, to a total dose of 130–475 mg/kg. The dogs died or were killed 7–44 days after the first injection.

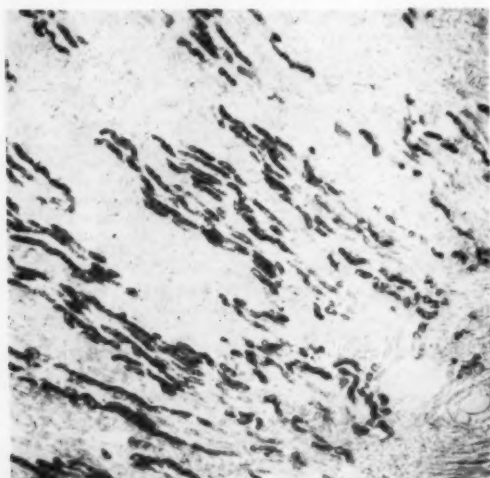


FIG. 1. Intracellular fat deposits in terminal parts of proximal convoluted tubules of the kidney, in a γ HCH-treated dog. Stained with Sudan black; magnification 22 \times .

The fat deposits are most marked in liver, striated muscle, nerve cells, and kidneys. They appear quite clearly in frozen sections of formaldehyde-fixed material, stained with general fat stains such as Sudan black or scarlach red.

Intracellular fat deposits in the kidney are limited to the proximal convoluted tubules (Fig. 1), the other tubules being practically free of fat droplets. Even in the proximal tubules, there is a precise distribution of the deposits, which may be formed by very big droplets. Whereas the glomeruli have a normal appearance and the initial parts of the tubules show only scattered and rare droplets, the terminal straight parts of the proximal tubules, or medullary segments of these tubules, contain numerous intracellular droplets. Some extracellular fat droplets are also to be seen in the lumen of

these tubules. There is no cell destruction or any alteration in nuclear structure, even in those parts of the tubules that are filled up with fat. The outer zone of the medulla shows no fat deposits. When the deposits in the proximal convoluted tubules are very rich, the lumen of the terminal parts of the collecting tubules and of the papillary ducts of Bellini may contain some fat and also some hyaline globules and cylinders. In the same animals, the epithelium of the calyces and the kidney pelvis may contain intracellular droplets.

Ureter, urinary bladder, urethra, and Littre's glands are free of fat deposits. In the male, one may sometimes see fat droplets in the epithelial cells of the prostatic portion of the urethra. This seems to be correlated with the abnormal amount of fat granules in the prostatic and Cowper's glands.

Treatment by the δ isomer of HCH produces the same distribution of fat deposits in the kidney, but they are in smaller amount. We have noticed no fat droplets in the kidney following intramuscular injections of big amounts of oil and DDT.

Our experiments allow us to conclude that this specific intracellular fat deposit in the kidney is bound to the still unelucidated biochemical lesion induced by hexachlorocyclohexane.

A Simple Apparatus for Multiple Uniform Intravenous Injections¹

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In the course of carrying out a study of total body water² on a large series of subjects, a simple method for the intravenous administration of precisely 50 ml of fluid was devised.

The apparatus consists of single unit (unit I, Fig. 1) calibrated to contain 50 ml. This unit is filled from a Baxter infusion bottle through the inlet (A). The inlet side-arm empties completely, thus eliminating any error from trapped air bubbles.

A two-way stopcock is provided for the outlet, allowing any excess of fluid (over the calibration mark) to be eliminated via the waste outlet (C).

The injection fluid is then delivered through the tubing (B). The reservoir of injection fluid (antipyrine solution, 1 g in 50 ml) was analyzed only once for each 20 subjects, as compared with 20 separate analyses when 50-ml syringes and separate 50-ml solution bottles were used for each subject.

A separate piece of tubing, with a glass adapter and needle attached, is autoclaved as a unit (II), and changed for each subject. In this manner, the hazards from injecting refluxed blood to successive subjects are eliminated.

¹ The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

² Using the "antipyrine technique" of Messenger & Steele.

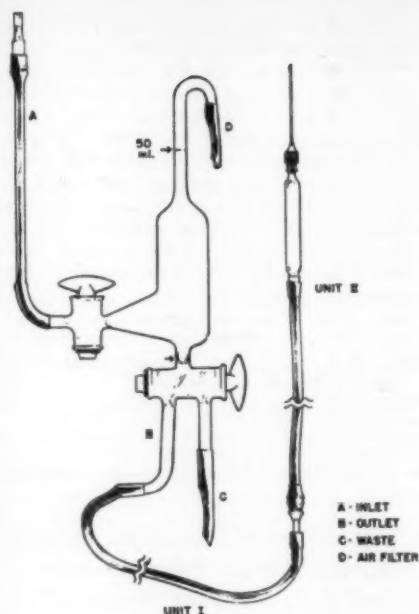


FIG. 1. Multiple sterile infusion apparatus.

The two stopcocks are greased with "high vacuum" grease supplied by Dow Corning Co. This silicon lubricant withstands temperatures over 200° C and may be repeatedly autoclaved without deterioration.

By means of this setup, the difficulty attending the sterilization of a large number of syringes was by-passed, and it was felt that the volume of injection fluid could be more accurately controlled. Using a No. 20 gauge needle, the injection time for 50 ml ranged between 4 and 5½ min. This apparatus was used successfully on over 50 subjects without a single untoward reaction.

Plasma Concentrations of *p*-Aminosalicylic Acid (PAS) Increased by *p*-(Di-*n*-propylsulfamyl)benzoic Acid

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PAS is being applied increasingly to the treatment of tuberculosis, the daily dose being 8-16 g. The amount of this dose is based on patients' ability to tolerate PAS medication, not on the belief that it represents the optimal dose; indeed, some workers believe that 20 g

¹ The authors wish to express their thanks to Drs. Charles A. Heiken and Peter A. Theodos, chiefs of service of the Department of Chronic Diseases of the Chest, Philadelphia General Hospital, for the privilege of studying patients on their services. The technical assistance of Mrs. Alice E. Pitt is gratefully acknowledged.

per day would be desirable (3). Therefore, an agent capable of enhancing the plasma concentrations of PAS would be worthy of attention, for although a direct relationship between plasma concentrations of PAS and therapeutic effect has not been established, this relationship, within limits, can be anticipated.

It was shown (4) that carinamide reduces the renal clearances of PAS to glomerular filtration rate, supposedly by inhibiting tubular excretion of PAS. But the suggestion was made that the same elevation in plasma concentrations of PAS produced by inhibiting the excretory function of the tubules would be observed if a form of PAS, less readily cleared by the renal tubules, was presented to the kidney for excretion. The concept that the catabolism (conjugation) of PAS may be altered in such a way as to slow its elimination gains support from the demonstration that carinamide acts upon an enzymatic conjugase system (1). A new compound *p*-(di-*n*-propylsulfamyl)benzoic acid, Benemid,² also has been shown to influence an enzymatic conjugation system that tentatively is regarded as related to the reversible inhibition of the excretion of penicillin and *p*-aminohippurate (2). The possibility that Benemid might inhibit the conjugation of PAS, and thereby retard its elimination from the body, prompted this investigation.

Seven patients with tuberculosis whose renal functions were unimpaired as determined by microscopic examination of the urine, blood urea nitrogen determinations, and phenolsulphonphthalein excretion tests were chosen for this investigation. In the fasting state, each patient was studied on three occasions: (A) after a single 4-g oral dose of PAS³ (administered as NaPAS in aqueous solution); (B) after a 4-g oral dose of PAS and a single 2-g oral dose of Benemid; and (C) after a 4-g dose of PAS that was administered subsequent to premedication for 24 hr with 0.5 g of Benemid every 6 hr. The test doses of PAS were administered when the patients were in the fasting state, and blood samples for plasma determination of PAS were drawn at ½, 2, 4, 6, and 8 hr after administration of PAS. Plasma determinations of PAS were done by the method of Way (5).

The mean plasma concentrations⁴ for the three periods of study were for treatment A, 1.00 mg PAS/100 ml blood; for treatment B, 1.71 mg/100 ml; and for treatment C, 2.63 mg/100 ml. These means were determined with a standard error of ± 0.20 mg/100 ml, and the 95% confidence limits are ± 0.44 mg/100 ml. Thus, treatment B gave significantly greater plasma concentrations of PAS than treatment A ($P < 0.05$), and treatment C gave plasma concentrations of PAS significantly

² Benemid is Sharp and Dohme's trademark for *p*-(di-*n*-propylsulfamyl)benzoic acid. Tentatively, the compound has been given the nonproprietary chemical name "probenecid."

³ Supplied through the courtesy of Sharp and Dohme, Inc., in the form of Propasa, an effervescent tablet of PAS that permits formation of NaPAS immediately prior to administration of the drug.

⁴ The ½- and 2-hr plasma concentrations were eliminated from the statistical analysis because these samples were drawn during the period required for PAS from the single oral dose to be absorbed and distributed in the body fluids.

greater than treatment B ($P < 0.01$). The results are presented in Fig. 1.

A single 2-g dose of Benemid (treatment B) elevates by 1.6 to 2.1 times the plasma concentrations of PAS observed 4, 6, and 8 hr after a single 4-g dose of PAS. A daily dose of 2 g of Benemid administered in 0.5-g doses every 6 hr (treatment C) elevates by 2.3 to 4.1 times the plasma concentrations of PAS observed at the same time intervals after 4 g of PAS.

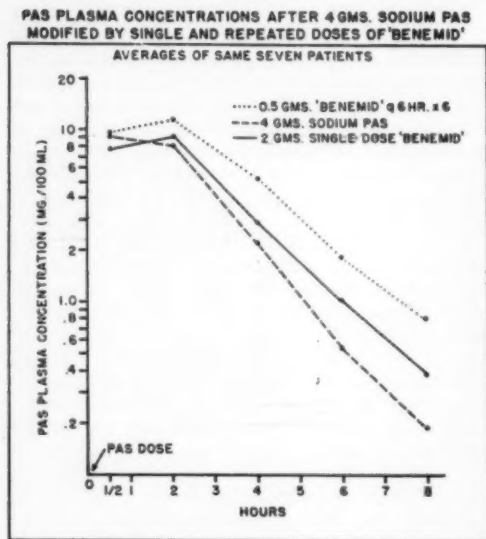


FIG. 1.

Because of the stability of Benemid and the absence of a free amine group in its structure, noninterference of the compound with the Way method might be anticipated. Repeated tests have shown that Benemid does not give a color reaction when samples were analyzed by the Way procedure.

Benemid, a crystalline white powder, is nearly insoluble in water.⁵ Initially the drug is tasteless but a bitter taste is noted occasionally, which is then displaced by a pleasant aftertaste. The drug is absorbed rapidly from the gastrointestinal tract, and, after a single oral dose administered to dogs, it can be demonstrated in the plasma for as long as 36 hr. Nearly 75% of the drug is bound to plasma proteins and it is excreted in the urine almost entirely in conjugated form, probably as a glucuronide. Both acute and chronic toxicity studies in mice and dogs have shown a high therapeutic index for Benemid (4). Benemid has been administered daily to human patients for 3 weeks without any observed toxicity.

PAS is conjugated before excretion, and, of the total amount of PAS excreted in the urine, "approximately 59% is AcPASA, 18% is PASA, 13% is *p*-aminosalicy-

⁵ The chemistry of this substance and related substances will be published by Miller, Zeigler, and Sprague.

luric acid and the remainder represents one free amine and one conjugated amine which are highly water soluble" (5). It is suggested that Benemid inhibits the conjugation of PAS so that the drug is presented to the kidney for excretion in a form that is less rapidly excreted than are the conjugates of PAS. An adequate dose of Benemid in combination with PAS would be expected to result in more prolonged and higher plasma concentrations of PAS, and on the basis of the observations here reported, the plasma concentrations of PAS are enhanced two to four times. Therefore, Benemid may extend and greatly increase the efficacy of PAS in the treatment of tuberculosis.

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The Composition of Meconium: Isolation of Blood-Group-Specific Polysaccharides. Abnormal Composition of Meconium in Meconium Ileus

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Meconium, the first intestinal discharge of the newborn, differs in appearance and properties from the stools of later life. It represents material accumulated during fetal life and is free of bacteria or their breakdown products. In the human infant it is blackish-green, odorless, has a viscid, sticky consistency, and varies in amount from 60 to 200 g. It is first demonstrable during the fifth month of gestation. Generally it is considered to be an accumulation of debris consisting of desquamated cells of the alimentary tract and skin, lanugo hairs, fatty material from the vernix caseosa, amniotic fluid, and various intestinal secretions. Its color is thought to be due to bile pigments (12). In a pathologic condition called "meconium ileus" (8), the amount of meconium is greater and its consistency even more viscid than is normal. This disorder is thought to represent the earliest and most severe form of cystic fibrosis of the pancreas, a disease characterized by diminution or absence of pancreatic enzymes. Neither normal nor abnormal meconium has as yet been studied by modern methods.

Analysis of meconium. In Table 1 is listed the composition of a pooled sample of normal meconium, as well as that of a specimen obtained from an infant with meconium ileus. Considering first the normal meconium, it may be seen that, as compared with adult stools, the

TABLE 1
ANALYSIS OF MECONIUM OF NORMAL INFANTS AND PATIENT WITH MECONIUM ILEUS*

Meconium	Dry weight	On dry weight basis					Non-protein N	Purines	Free reducing sugar	Acid-soluble phosphorus
		Ash	Nitrogen	Alcohol-ether extractable	Total reducing sugar	Total phosphorus				
		%	%	%	%	%				
Normal:	27.6	4.0	6.9	12.3	35.5	0.04	84.1	1.4	3.1	57
Ileus:	20.8	1.8	14.4	9.7	8.7	0.07	5.4	2.9	2.7	9

* The determinations for dry weight, ash, nitrogen, material soluble in alcohol-ether, and total phosphorus were performed according to standard methods. The total sugar was determined after hydrolysis for 2 hr at 100° C in normal acid by the method of Nelson (7). Nonprotein N and acid-soluble P were estimated on the trichloroacetic acid filtrate. The purines were determined according to Hitchings (4) with the use of double precipitation.

water content was high, and the ash content extremely low. Nitrogen, purine, and phosphorus, even on a dry-weight basis, were low and, for the most part, water- and trichloroacetic acid soluble. No protein could be demonstrated by heat or the usual precipitants. Relatively little lipid material was present. The most prominent component appeared to be a polysaccharide, which yielded a reducing sugar after acid hydrolysis. These data are incompatible with the prevailing ideas about the composition of meconium as a chance collection of debris; they indicate the presence of a specific component, carbohydrate in nature, as a consistent major constituent.

The meconium from the patient with ileus differed markedly in composition from the normal. It was much higher in nitrogen, which for the most part was precipitable by trichloroacetic acid, as were the phosphorus and purine. Qualitative protein reactions were positive. The percentage of carbohydrate was relatively low. The absolute amount, however, may well have been normal; although a quantitative collection was impossible, it appeared that the amount of meconium was much greater than usual.

The next phase of the study was directed toward elucidation of the nature of the carbohydrate. It appeared to exist in combination with nitrogenous substances and to represent a mucopolysaccharide. The polysaccharide was water soluble and precipitable by 10 volumes of glacial acetic acid or 5 volumes of ethanol. It was not precipitated by various deproteinizing agents. Most of the bile pigment could be removed by acetic acid, alcohol, or treatment with barium hydroxide and ZnSO₄ (Somogyi deproteinization). The solutions of the polysaccharide were translucent, with a light yellow or greenish tinge. The reducing substance was nonfermentable. Specific color reactions were positive for glucosamine, galactose, and methylpentose. Mucic acid could be isolated. Hexuronic and sulfuric acids were absent. A product prepared by preliminary removal of interfering substances by barium hydroxide and ZnSO₄, followed by precipitation with glacial acetic acid, yielded the following data: N, 4.3%; reducing sugar (Somogyi-Nelson), 32.1%; glucosamine, 18.8%; acetyl, 6%. Further preparations were made following the procedures of Morgan

and King (6) or Sevag (11). Their composition is discussed in a later section. The general similarity of the polysaccharide to blood group substances prompted the investigation of the blood group activity of meconium.

TABLE 2
BLOOD GROUP ACTIVITY OF BLOOD, SALIVA, AND MECONIUM*

Sample of meconium	Blood	Saliva	Approximate amount of meconium inhibiting isoagglutination	
			A	B
All.	O	—	—	—
Wil.	O	—	—	—
Fel.	A	A	0.1	—
Kel.	A	A	0.1	—
McD.	A	A	0.1	—
Tho.	A	A	0.05	—
Wel.	A	A	0.7	—
Bon.	B	B	—	0.7
Hug.	B	—	—	—
Spr.	B	B	—	0.7
Wil.	AB	AB	60	60
Wrl.	AB	AB	70	10

* The tests were carried out according to the technique of Morgan and King (6): 0.1 ml of diminishing concentrations of the material was mixed with 0.1 ml of human anti-A or anti-B serum containing 20–40 agglutinating doses. After standing 1 hr, 0.1 ml of an 0.5% suspension of standardized A or B erythrocytes in 0.9% NaCl was added. After 2 hr at room temperature, the mixtures were centrifuged and examined macro- and microscopically for agglutination. Minimal agglutination was taken as the end point. The figures in the table refer to the amount of material in 0.1 ml of solution tested. The dashes indicate lack of activity with the highest amount tested, usually 1,000 µg.

Blood group activity of meconium.¹ The activity of meconium was assessed by its ability to inhibit isoagglutination according to the procedure of Morgan and King (6), with 20–40 agglutinating doses of human anti-A or anti-B serum. It was found that a sample representing a pool of 25 meconium stools neutralized both A and

¹ Blood group activity of meconium has been noted by several observers (9, 10, 13–15).

TABLE 3
COMPOSITION OF TYPE-SPECIFIC POLYSACCHARIDES OF MECONIUM

Fraction	Nitrogen	Reducing sugar	Hexosamine*	Acetyl*	Methyl pentose*	Katlo	Ratio	Ratio	Blood group activity*	
									A	B
	%	%	%	%	%	4/2	4/3	5/4	μg	μg
<i>Analysis of pooled meconium†</i>										
Crude	7.1	26.2	15.3	5.0	3.5	.17	.59	1.36	2.5	30
Mo. I	5.4	34.7	23.2			.33	.67		10	25
Mo. II	5.1	43.9	28.4	8.9	6.0	.43	.65	1.30	0.5	25
Mo. III	5.8	22.4	13.5			.19	.60		2.5	250
Sevag III	6.0	42.6	25.9	9.6	5.3	.34	.61	1.54	0.1	16
<i>Analysis of individual meconiums</i>										
Sevag purification										
McD. Group A	6.6	37.3	23.2	8.2	7.7	.27	.62	1.47	0.01	—
Bon. Group B	6.7	37.0	22.0	6.6	6.0	.25	.60	1.24	—	0.01
Wrl. Group O	6.7	40.0	23.0	7.5	5.2	.27	.58	1.36	100?	—
Wrl. Group AB‡	6.2	41.6	24.8	7.4	8.4	.31	.60	1.24	—	0.2
Calf meconium										
Crude	6.2	12.0	6.8		1.0	.08	.57		—	—
Sevag	5.4	36.6	22.8	8.0	4.6	.33	.62	1.46	—	—

* Hexosamine was determined according to Elson and Morgan (3), acetyl, by a modified method of Kabat and Mayer (5), methyl pentose by the CyR10 reaction according to Dische (2), and the blood group activity by the procedure of Morgan and King (6).

† The fractionation was performed according to Morgan and King (6). Fraction Mo. I represents material insoluble in 90% phenol, fraction Mo. II that precipitating in 27% alcoholic phenol, and fraction Mo. III, the material insoluble in 50% alcoholic phenol. The Sevag purifications were performed by shaking repeatedly aqueous solutions of meconium brought to pH 4.8 by the addition of sodium acetate and acetic acid, with one-fourth volume of a 10:1 mixture of carbon tetrachloride and amyl alcohol. After four to eight extractions, the supernatant material was precipitated with six volumes of absolute alcohol.

‡ The blood cells of Wrl. were only weakly agglutinated by anti-A, but strongly by anti-B serum. The crude meconium showed A group activity in amounts of 70 μg but B activity with 10 μg. On purification the A activity disappeared. Possibly it represented a subgroup of A.

B agglutinating sera in amounts of 25 μg and 300 μg, respectively. The next step was to determine whether the activity of the meconium of an individual infant's stool corresponded to his blood group and whether a distinction existed between "secretors," i.e., infants whose body secretions contain water-soluble, group-specific substances, on the one hand, and nonsecretors on the other, i.e., infants whose body fluids lack this property. Individual samples of meconium, blood, and saliva from a group of 12 infants were tested. It may be seen from Table 2 that the activity of meconium paralleled the properties of saliva. Both saliva and meconium of the infants of blood group O were devoid of A or B activity, whereas the materials from infants of blood group AB had both A and B activity. Meconium from infants of group A showed somewhat higher activity than that from infants of group B and both were considerably more potent than meconium from infants of group AB. Both saliva and meconium of one nonsecretor of blood group B were found inactive, indicating that the activity of meconium is restricted to secretors.

Chemical composition of polysaccharides of meconium. Table 3 summarizes the chemical data on polysaccharides obtained from pooled and individual meconiums from infants of different blood groups. It may be seen that, on the whole, the composition of the purified fractions is in agreement with products obtained from other sources

(1). It is noteworthy that the crude meconium had a high polysaccharide content, estimated from its reducing value to represent over 80% of its weight, but that it contained an excess of nitrogenous substances. Fraction Mo. II, corresponding to the best fraction of Morgan and King (6), was highest in sugar and lowest in nitrogen content, and would appear to be purest by these standards. However, its blood group activity was, if anything, lower than that of the Sevag III fraction, which was higher in N and lower in sugar. There was evidence of fractionation in the phenol procedure between A and B activity of the pooled meconium, the B activity being associated with the most insoluble fraction, Mo. I. The Morgan procedure gave distinctly inferior yields of polysaccharide as compared to the Sevag method, which led to a recovery of about 50% of the reducing sugar of meconium in purified form. The analysis of polysaccharides of individual meconiums of different blood groups showed only minor differences in composition. Those from individual meconiums of A or B individuals were considerably more active than the preparation from pooled stools. They appeared to be even more potent than the products described by Morgan, but little stress should be laid on differences observed in different laboratories, in view of the nature of the serologic method. The analyses on the meconium from a calf fetus² indicated

² Obtained through the courtesy of Louis Kahn, of Cincinnati.

a polysaccharide content much lower than that of human meconium. The purified polysaccharide, on the other hand, resembled the human polysaccharides closely, but was devoid of human blood group A or B activity.

The observations reported are as yet of a preliminary nature and require elaboration in several directions. From the present data, it would appear that meconium in the first instance represents the residue of the mucous secretions of the entire alimentary tract, including saliva and gastric and intestinal juices. It is known that in secretors the secretions of many glands normally contain mucoproteins and exhibit blood group activity. The absence of protein from normal meconium may be attributed to the activity of proteolytic enzymes, foremost trypsin, which would digest the protein while leaving the polysaccharides intact. The different composition of the meconium from the infant with meconium ileus might then be due to the lack of proteolytic activity, which would lead to the persistence of protein. The much greater than normal viscosity of meconium of infants with ileus would find its explanation in the circumstance that mucoproteins are more viscous than mucopolysaccharides. The observations on calf meconium would indicate that the occurrence of polysaccharides in meconium is not restricted to man.

The availability of a potent and easily accessible source of human blood group substances in the form of meconium appears of great theoretical and practical interest. It opens the possibility of study of hitherto practically inaccessible blood group substances and of a close comparison between human and animal products. Blood group substances from meconium offer great promise in blood transfusion practice as neutralizing agents of agglutinins of pooled plasma or blood, and have the advantages over currently used products of high potency, simple purification, and certain absence of antigenic properties.

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Taste Reactions to Antithyroid Substances

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Fox discovered a number of years ago (4) that some persons taste phenylthiourea (phenylthiocarbamide, or PTC) as distinctly bitter, whereas others find it nearly or quite tasteless. Family studies have shown (2, 6) that this taste ability is hereditary, the nontasting characteristic being in all probability a recessive gene. About 25% of most populations are nontasters for PTC, although there are racial and sexual variations. The discovery by Fisher, Ford, and Huxley (3) that chimpanzees can likewise be divided into tasters and nontasters for PTC makes it seem probable that this gene pair has existed in man for a very long time.

Thus, a gene appears to exist which enables its possessor to taste a synthetic compound not known to occur in nature. It is not too easy to understand how such a gene can exist, nor to guess what its function can be.

A possible explanation for this gene's existence appears to have been demonstrated in this laboratory. The substance 1-5-vinyl-2-thio-oxazolidone, recently isolated and structurally defined (1), occurs widely in nature, particularly in turnips and cabbage. A sample was kindly sent by Dr. M. G. Ettlinger, and tests were made on 21 individuals, of whom 7 could not taste PTC, 13 tasted it as bitter, and 1 tasted it as bitter after some delay. Ability to taste 1-5-vinyl-2-thio-oxazolidone was found to parallel exactly that for PTC. There can be little doubt that the same gene controls ability to taste this naturally occurring substance.

In regard to the "purpose" of the tasting gene, it is known that thiourea, thiouracil (5), 1-5-vinyl-2-thio-oxazolidone, and other substances of similar constitution act as antithyroid drugs. This seems to point to some connection between the tasting gene and thyroid function. It is planned to test hypothyroid and hyperthyroid patients for ability to taste substances of this group and thus investigate further the possible relation between the "tasting" gene and glandular function.

It is realized, of course, that the relationship may be less direct than seems obvious at first. In fact, Fisher, Ford, and Huxley (3) suggest that the reason for the long survival in man of both the tasting genes might be that the heterozygote had some (unspecified) advantage over both the homozygotes. Examples of this have been observed in *Drosophila*.

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Comments and Communications

Dimenhydrinate vs. Diphenhydramine

The recent comments by Mark Nickerson (*Science*, 1950, 111, 312) are pertinent ones; he suggests that, in view of the lack of evidence for any pharmacological action of 8-chlorotheophylline, it would seem improbable that dimenhydrinate (i.e., diphenhydramine-8-chlorotheophyllinate) should possess therapeutic properties differing appreciably from those of the antihistamine component, diphenhydramine. This point is even more valid in view of clinical demonstrations of the antinauseant and antiemetic effects of several antihistamine drugs in some of those conditions for which dimenhydrinate has been advocated, viz., motion sickness, nausea, and vomiting of pregnancy.

However, with reference to the treatment of radiation sickness it has been claimed (Tillisch, J. H. *Proc. Staff Meet. Mayo Clin.*, 1949, 24, 477) that dimenhydrinate is more effective than other more potent antihistamines, and some specificity of action for this drug in depressing the vomiting center is suggested. Quite recently, evidence has been presented favoring the slight protective action of 8-chlorotheophylline in airsickness (Chinn, H. I., and Oberst, F. W. *Proc. Soc. Exp. Biol. Med.*, 1950, 73, 218) although the same study failed to disclose any superiority of dimenhydrinate over diphenhydramine. Most recently, however, experiments have been described (Chen, G., and Ensor, C. R. *J. Pharmacol. exp. Therap.*, 1950, 98, 249) showing the equivalent effectiveness of diphenhydramine and dimenhydrinate, and the lack of effectiveness of 8-chlorotheophylline in protecting dogs against apomorphine-induced vomiting.

A few months ago we undertook some preliminary experiments to ascertain any possible antiemetic specificity for dimenhydrinate as compared to diphenhydramine. In a group of three cats the reliable emetic dose of apomorphine was determined as 50-75 mg subcutaneously; with this dose emesis occurred invariably within 5-6 min. We determined next that, depending on the amount of emetic injected, dimenhydrinate by mouth 15 min prior to apomorphine protected the respective animals in a dosage of 50-100 mg.

These quantities of dimenhydrinate and diphenhydramine were compared for protective action, alternating the drug used and allowing adequate recovery intervals, and also retesting with apomorphine from time to time to detect any acquired resistance to the emetic action. In a series of 15 trials dimenhydrinate gave complete protection in 13 instances; in the other 2 instances vomiting occurred in 14 min and 48 min. In a series of 12 trials diphenhydramine gave complete protection in only 2 instances; in the other 10 instances vomiting occurred in 20-90 min.

These preliminary results suggest to us some superiority for dimenhydrinate over diphenhydramine. In view of the fact that equal quantities were tested, and that the

antihistamine base represents only about 55% of the weight of dimenhydrinate, it would seem that the antiemetic action of the latter drug is not predicated solely on the basis of its antihistamine component. Since diphenhydramine does offer some protection—in that vomiting is appreciably delayed as compared to untreated animals—it may be that, as a result of different absorption and excretion rates, higher blood or tissue levels are maintained for a longer period with dimenhydrinate than with diphenhydramine.

Later experiments have suggested a high degree of protection with 8-chlorotheophylline, but these results cannot yet be considered significant, since it is apparent that the animals have now developed some resistance to the emetic action of apomorphine.

A continuation of these experiments on a larger number of animals will be described in detail at a later date.

LEONARD MITCHELL

Research Laboratories

Frank W. Horner Ltd., Montreal, Quebec

On the Theory of Odors

I cannot resist the temptation to add one more hypothesis on the nature of the sensation of smell to speculations of others on this subject. Several characteristic traits of this sense can be accounted for without infringing on basic physical principles if it is attributed to the inhibition of certain enzymes contained in the olfactory organs. Suppose that a system of enzymatically catalyzed reactions represented schematically, for instance, by $A \rightarrow A' \rightarrow A''$; $B \rightarrow B' \rightarrow B''$; $C \rightarrow C' \rightarrow C''$; etc., is causally related to the olfactory nerve signals. Each step, as $A \rightarrow A'$ or $A' \rightarrow A''$, is catalyzed by a separate enzyme, and each of the compounds A' , B' , C' , etc., in a number related to the number of basic smells, is capable of causing a signal in a distinct nerve when its concentration is altered. This particular reaction scheme is of course not essential to the following. What is essential is some mechanism by which changes in concentration of several active enzymes are converted into distinguishable nerve signals. The effect of a compound possessing the property of odor is the inhibition of one or more of these enzymes, causing a shift in relative concentrations of A' , B' , C' , etc., and thus producing signals in the nerves that respond to these compounds.

This proposal has the merit of accounting for a number of known traits of the sense of smell: (1) high smell sensitivity becomes plausible because the quantities of the enzymes involved may be exceedingly minute; the intensity of smell becomes related to the extent of inhibition; (2) the wide range of compounds having odor becomes understandable because enzymes are frequently inhibited by a great variety of compounds and yet show definite selectivity in this respect; (3) complex odors are seen to be the result of inhibition of several of these

enzymes by the compound in question, and apparent changes in the quality of smell with the concentration are the result of (nearly) total inhibition of some of the enzymes; (4) reversibility of most odors corresponds to the reversibility of many enzyme inhibitions, but there is the possibility of nonreversible inhibition by other compounds, which corresponds to the persistence of certain odors.

As I have no means for carrying out physiological experiments and, moreover, have not conceived of any tests which might be termed crucial for this hypothesis, it is being offered as a mere speculation.

G. B. KISTIAKOWSKY

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Errata

In the article "Hemophilia in the Female Dog," by Kenneth M. Brinkhous and John B. Graham (*Science*, 1950, 111, 723), the caption for the fourth column in Table 2, on page 724, should read: "Prothrombin utilized during 1st hr."

In the article "The Availability of Various Manganese Oxides to Plants," by G. W. Leeper (*Science*, 1950, 111, 463), two lines should be inserted after the word "failed" (col. 2, par. 2): "to distinguish between them. However, a solution of quinol in water with no added electrolyte gave quite a . . ."

Book Reviews

The Nature of Physical Reality: A Philosophy of Modern Physics. Henry Margenau. New York-London: McGraw-Hill, 1950. 479 pp. \$6.50.

In this very interesting book Prof. Margenau, a theoretical physicist by profession and a philosopher par excellence, presents his views on the philosophical foundations of modern physics. Although as a rule there are as many opposing philosophical systems as there are people thinking about them, they can usually be divided into groups bearing well-established names. Thus we learn that "Planck and Einstein are critical realists, Eddington and Weyl moderate idealists, and Bohr and Heisenberg vaguely display the colors of positivism" (p. 12). In this sense the author of the book can probably be described as the proponent of the Neo-Kantian school of thought, inasmuch as he states (p. 58) that

clear cognizance of the distinction between *synthesis* and *integration* on one side, and *imaginative supplementation* of the perceptually given on the other, has been apparent in the Kantian and Neo-Kantian school of thought, and much of the emphasis conferred upon this point by that school is now indispensable as a condition for comprehending modern science.

With this *modus operandi* the author enters into a detailed discussion of the fundamental notions of space and time, and their union in the form of Einstein-Minkowski's four-dimensional world. This is followed by an interesting presentation of the basic problems of statistical mechanics and their bearing on the philosophical interpretation of the laws of probability. The last third of the book is devoted to the problems of quantum theory, causality, and the exclusion principle. It is in this part that a philosopher will become particularly aware of the enormous impact made upon his traditional problems by the factual discoveries of science. Being an expert in the field of theoretical physics, the author presents his material with great clarity, entering into a discussion of such ultramodern problems of physical theory

as the current difficulties of quantum electrodynamics and the problem of elementary particles.

On the whole, this book presents an invaluable source of information for a philosopher who would like to get the authoritative up-to-date picture of the advances of modern physics. On the other hand, the reviewer is not quite sure about the use that can be made of his book by the professional physicists, but it is probably because he belongs (p. 13) to

the ranks of the exterminator brigade, which goes noisily about chasing metaphysical bats out of scientific belfries.

GEORGE GAMOW

Los Alamos, New Mexico

Lehrbuch der Theoretischen Physik: Physik der Vorgänge-Bewegung, Elektrizität, Licht, Wärme, Bd. I. Walter Weizel. Berlin W35, Germany: Springer-Verlag, 1949. 771 pp. DM 56.90 bound, 53 paper-bound.

This is an excellent text, written with the thoroughness that comes from a deep understanding of the unity and coherence of classical theoretical physics. This is not to say that the subject is considered as finished and complete. The limitations are carefully pointed out and, where appropriate, hints are given as to the successes of quantum theory to be treated in the second volume, which is to deal with the theory of matter.

The present volume includes classical mechanics, elasticity, hydrodynamics, electrodynamics, optics, relativity, and thermodynamics. Each of these fields is treated thoroughly. Although the material is presented in concise form the treatment is not sketchy; sufficient detail is always given to enable the reader to follow the line of argument without difficulty. The subject of mechanics, for example, is covered in 138 pages, starting with the motion of a particle, then discussing motion of a system of particles, introducing the Lagrange equations of the first and second kind for free and constrained

motion, the integral principles of dynamics, the Hamilton-Jacobi theory, periodic and conditionally periodic motion, and the use of the action function, thus leading toward a natural transition to wave mechanics.

Elasticity and hydrodynamics cover 175 pages. Besides the usual topics, some elementary applications to problems in applied mechanics are used to illustrate elasticity theory. Vibrations and the theory of wave propagation in elastic media, and the effect of boundary conditions, are treated with particular clarity. Hydrostatics, surface phenomena, the hydrodynamics of ideal and viscous fluids, and wave propagation in fluids, including a brief account of supersonic flow, complete the chapter.

Another 175 pages are devoted to electrodynamics, including a section on the application of 4-terminal networks, and a brief account of the matrix theory of networks. A chapter on optics, of 125 pages, covers geometrical optics, interference, diffraction, and crystal optics. These two chapters prepare the way for the necessity of introducing relativity theory, which is presented in a particularly lucid chapter of 60 pages, covering the electrodynamics of moving bodies and the formulation of the field equations in Lorentz-invariant form, ending with a brief section on ground relativity.

The volume concludes with a 98-page chapter on thermodynamics. This includes classical thermodynamics: the thermodynamic potentials, phase rule, Nernst's theorem, applications to chemistry, as well as theory of heat radiation, and a brief treatment of heat conduction. Statistical treatment is reserved for the second volume, as are all topics depending on the atomic nature of matter.

A useful feature of the book is a brief paragraph at the beginning of most sections, describing the topics treated in that section and setting forth the notation used therein. The English language is peculiarly lacking in comprehensive treatments of theoretical physics at the graduate level; the nearest approach to the present volume is perhaps the translation of Joos's *Theoretical Physics*. Weizel's book is a bit more advanced than Joos's. It is highly recommended as a text for a year's course in classical theoretical physics. The postwar shortage probably accounts for the quality of paper on which the book is printed. This is considerably below the former Springer standard, though the technical excellence of the printing and the freedom from errors are up to standard.

G. G. HARVEY

Massachusetts Institute of Technology

Scientific Book Register

Stellar Evolution: An Exploration from the Observatory. Otto Struve. Princeton, N. J.: Princeton Univ. Press, 1950. 266 pp. \$4.00.

Gray's Manual of Botany: A Handbook of the Flowering Plants and Ferns of the Central and Northeastern United States and Adjacent Canada. 8th ed. Revised by Merritt Lyndon Fernald. New York: American Book Company, 1950. 1632 pp. \$9.50.

Atomic Physics. Wolfgang Finkelburg. Trans. from rev. German ed. by George E. Brown. New York: McGraw-Hill, 1950. 498 pp. \$6.50.

Saints, Sinners and Psychiatry. Camilla M. Anderson. Philadelphia, Pa.: J. B. Lippincott, 1950. 206 pp. \$2.95.

Therapeutische Chemie: Arznei- und Desinfektionsmittel zur Bekämpfung von Infektionskrankheiten. Theodor Wagner-Jauregg. Bern, Switzerland: Hans Huber; New York: Grune & Stratton, 1949. 272 pp. Sw. fr. 35.50.

Structure et Activité Pharmacodynamique des Médicaments du Système Nerveux Végétatif: Adréline, Acétylcholine, Histamine et Leurs Antagonistes. D. Bovet and F. Bovet-Nitti. Basel, Switzerland: S. Karger Ltd., 1948. 849 pp. Sw. fr. 85.-.

Physical Properties of Glass. J. E. Stanworth. New York: Oxford Univ. Press, 1950. 224 pp.

Weltschöpfung in Mythos und Religion, Philosophie und Naturwissenschaft. Bernhard Bavink. Basel, Switzerland: Ernst Reinhardt, 1950. 126 pp. Sw. fr. 5.50.

The Production of Antibodies. 2nd ed. F. M. Burnet and Frank Fenner. London-New York: Macmillan, 1949. 142 pp. \$3.00.

The Pathogenesis and Pathology of Viral Diseases: Symposium Held at the New York Academy of Medicine, December 14 and 15, 1948. John G. Kidd, Ed. New York: Columbia Univ. Press, 1950. 235 pp. \$5.00.

Physics in Industry: The Acceleration of Particles to High Energies. London S.W.1, England: Institute of Physics, 1950. 58 pp. \$1.60 postpaid.

Process and Unreality: A Criticism of Method in Whitehead's Philosophy. Harry Kohlsant Wells. New York: King's Crown Press, Columbia University, 1950. 211 pp. \$3.00.

An Introduction to Probability Theory and Its Applications, Vol. I. William Feller. New York: John Wiley; London: Chapman & Hall, 1950. 419 pp. \$6.00.

Exercises in General Chemistry. Harold G. Dietrich and Erwin B. Kelsey. New York: Macmillan, 1950. 285 pp. \$3.00.

Die Welt der Vektoren: Einführung in Theorie und Anwendung der Vektoren, Tensoren und Operatoren. Franz Ollendorff. Vienna, Austria: Springer-Verlag, 1950. 470 pp. \$9.00 paper, \$9.60 bound.

A Course in General Chemistry: Semi-Micro Alternate Form. 3rd ed. William C. Bray, Wendell M. Latimer, and Richard E. Powell. New York: Macmillan, 1950. 217 pp. \$3.00.

News and Notes

International Ecology Colloquium

Robert W. Pennak

Biology Department, University of Colorado, Boulder

The Centre National de la Recherche Scientifique, with the cooperation of the Rockefeller Foundation, sponsored a colloquium titled "Ecologie des Groupements Animaux et Mixtes" in Paris, from February 20 to 25. This was one of a series of international scientific colloquia organized by the Centre, and all the 30 contributors were invited individually by the Centre.

Two half-day sessions were held each day. Ten such sessions assembled at the Curie Institute, one at the Trappes Meteorological Station, and the final session in the Cauchy Amphitheater, of the Sorbonne. The size of the audience ranged from 40 to 70 persons. Most of the correspondence and arrangements were handled by Professors Prenant and Pacaud of the Sorbonne.

Only two or three papers were presented at each half-day session; consequently there was ample time for discussion, which often proved lively and stimulating. Contributions covered widely varied phases of animal ecology and several associated aspects of plant and general ecology. Some of the papers were general summaries; others dealt with narrow phases of certain ecological investigations.

Among the terrestrial animal ecologists, Franz emphasized the inadequacy of our taxonomic knowledge of the soil microfauna, as well as the complex and poorly known biological interrelationships among various groups. Kuhnelt contended that soil biotic communities are not superorganisms but an accumulation of organisms with relatively stable composition, united by similar environmental requirements and interspecific relations. He maintained that there is a "regionale Stenozonie," which characterizes the different community relations of the same species under different climatic conditions. Agrell discussed the physiology of the diapause with special reference to the butterfly *Phalera bucephala*; he emphasized the enzymatic control of the diapause and the probable limiting influence of an unknown vitamin. De Backer outlined some of the technical difficulties to be overcome in designing recording instruments for microclimatology.

Marine papers included a summary of the composition

of bottom animal communities by Thorson. Wilson emphasized the fact that the larvae of many bottom-inhabiting species, especially polychaetes, swim or drift over the bottom until they come in contact with a specific type of substrate, where they settle and metamorphose to the adult stage. Drach discussed the use of self-contained diving equipment for the study of marine sublittoral areas; such apparatus is especially useful on rocky bottoms, where the usual sampling methods cannot be employed.

Petit and Schachter discussed the general animal ecology of brackish waters and the wide salinity- and temperature-variations in such environments. They emphasized the fact that brackish waters are characterized by few species and very few "indicator" species. Fauré-Fremiet summarized the ecology of interstitial Protozoa in marine and fresh-water sediments, stressing the diversity of food habits, ecological niches, and texture of substrate. Pennak compared interstitial sandy beach micro-metazoan faunas of lakes with those of intertidal marine beaches. The faunas of these two habitats are strikingly similar in the taxonomic groups represented, but fresh-water beaches contain many more species of rotifers, whereas marine beaches contain many more species of copepods. The chemical features of the interstitial capillary water vary widely, even in the course of each day.

Williams spoke on diversity as a measurable character of an animal or plant community; that is, a constant multiplication of the size of a sample produces a constant addition to the number of species represented in the sample. Some of the other general summarizing contributions included the dynamics of plant biotic communities (Gausson), biocenotics and social phenomena (Grasse), and biochemical roles played by anaerobic soil bacteria (Prevot).

Most of the papers were delivered in French or English, but a few were in German. An able interpreter implemented the discussion following each paper. All the contributions are scheduled for publication in a single volume.

The colloquium included official delegates from France, England, Austria, Denmark, Sweden, Switzerland, Belgium, and the United States. The general tenor of the colloquium and the many formal and informal discussions emphasized the fundamental importance and need for international cooperation in ecological research.

About People

Albert E. Dimond has been named chief of the Plant Pathology Department at the Connecticut Agricultural Experiment Station, succeeding James G. Horsfall, director of the station. Dr. Dimond has been assistant chief of his department since

April, 1949, and is co-director of the station's Atomic Energy Commission project, which was begun last year.

John C. Duncan, professor of astronomy at Wellesley College and director of the Whitin Observatory, Wellesley, Massachusetts, for the

past 40 years, retired June 30. He will be visiting professor of astronomy at the University of Arizona and visiting astronomer at the Steward Observatory, Arizona, during the ensuing year.

Richard A. Feynman will join the staff of the California Institute of

Technology this month as professor of theoretical physics. Dr. Feynman comes to Caltech from Cornell University, where he has been a member of the Laboratory of Nuclear Studies since 1945.

Max T. Goebel, assistant technical director of the Du Pont Company's Grasselli Chemicals Department, has been appointed technical director, succeeding **John C. Woodhouse**, who has undertaken a special assignment with the company.

Paul L. Munson, research associate, Department of Pharmacology, Yale School of Medicine, has been appointed assistant professor of dental science, Harvard School of Dental Medicine.

Vincent E. Parker, professor of physics and chairman of the Physics Department at the University of Delaware, will succeed **D. V. Guthrie** as professor and chairman of the Physics Department at Louisiana State University. Dr. Guthrie, a faculty member at LSU for the past 40 years, has resigned in order to do full-time teaching and research in astronomy.

Robley Williams, professor of physics at the University of Michigan, has been appointed professor of biophysics of the Virus Laboratory and Department of Biochemistry, University of California at Berkeley.

Visitors

George M. Volkoff, Canadian atomic scientist, is visiting professor this summer at the University of California, Los Angeles. Dr. Volkoff has been associated with the Chalk River, Ontario, atomic plant for several years. At present he is professor of physics at the University of British Columbia, Vancouver.

The National Bureau of Standards recently had the following visitors: **John James Dale**, head, Electrodeposition Group, Defense Research Laboratories, Marihyonong, Victoria, Australia; **Claude Decroley**, professor of metallurgy and electrochemistry, Université de Bruxelles, Belgium; **Heishiro Fuku-**

zawa, technical manager, Soda Department, and **Bumpel Yoshiki**, director, Research Laboratory, Asahi Glass Company, Ltd., Tokyo; **Francisco Mira**, Fundición Mira, Cordoba, Argentina; and **B. I. H. Scott**, lecturer in physics, University of Tasmania, Australia.

Recent visitors at the Communicable Disease Center, U. S. Public Health Service, Atlanta, were: **H. S. Sastry**, district health officer, Mysore State Department of Public Health, Bangalore, India; **Mohamed Ilyas**, assistant to director general of health services, Karachi, Pakistan; **Mohammad Safdar**, assistant medical officer, West Punjab Public Health Department, Pakistan; **Angel M. Ayala**, district health officer, Manatí, Puerto Rico; **Arvid Evjen**, health officer, Norway Public Health Service, Oslo; **Ruperto Angodung**, district health officer, Manila; **Hamdi Acan**, director, Malaria Control Service of Kocaeli Province, Izmit, Turkey; **Benjamin D. Cabrera**, instructor, University of the Philippines College of Medicine, Manila; **Conrado E. Batenga**, health officer, Bureau of Health, Philippines; **José A. Hernandez-Matos**, public health officer, Santurce, Puerto Rico; **Luis Flores Barroeta**, Lab-Parasitology, National Polytechnic Institute, Mexico; **Hans Doerner**, assistant to health officer, Karlsruhe, Germany; **Klaus Th. Von Brickern**, health officer, Rosenheim County, Bavarin, Germany; **A. Alfredo Serrano M.**, senior engineer, Servicio Cooperativo Interamericano, Cochabamba, Bolivia; and **Yuan-I Li**, sanitary engineer, National Institute of Health of China, Chungking.

Grants and Awards

Ohio State University has received a grant of \$10,000 from **E. I. du Pont de Nemours and Company**, for fundamental research in the Department of Chemistry, under direction of **Edward Mack, Jr.**, chairman of the department.

Rockefeller Foundation Grants for scientific work in the second quarter of 1950 have been made to the following: *Inter-American Institute*

of Agricultural Sciences, Turrialba, Costa Rica—\$11,100 for its Division of Animal Industry; *Yerkes Laboratories of Primate Biology, Inc., Orange Park, Florida*—\$90,000 for studies directed toward experimental analysis of the primate nervous system, under the direction of **Karl S. Lashley**, research professor of neuropsychology, Harvard University; *Laboratory of Human Development, Harvard University*—\$41,100 for studies of social and cultural factors in child development under the direction of **Robert R. Sears**; *University of Wisconsin*—\$20,000 for research in enzyme chemistry under the direction of **Philip P. Cohen**; *Columbia University*—\$12,000 for biological research by **John V. Taggart**; *Massachusetts General Hospital, Boston*—\$55,000 for the work of **Fritz Lipmann**, director of the Biochemical Research Laboratories; *United Nations Economic Commission for Europe*—\$12,000 to train European students in the social sciences; *Association of American Medical Colleges*—\$21,350 for its Medical Film Institute for production of a critical catalogue of medical motion picture films, under the supervision of **David S. Ruhe**, director of the institute.

In the medical sciences grants were made to: *Child Research Council of Denver*—\$25,000 for studies in child growth and development under the direction of **Alfred H. Washburn**; *Institute of the History of Medicine, Johns Hopkins University*—\$30,000; *Duke University*—\$30,000 for research in parapsychology directed by **Joseph B. Rhine**; *New England Medical Center, Boston*—\$30,000 for research in endocrinology directed by **Edwin B. Astwood**.

Grants in the natural sciences were made to: *Polytechnic Institute, Brooklyn*—\$136,115 for research on the structure of proteins; *Theodor Kocher Institute, University of Bern*—\$25,000 to aid foreign guests working at the institute; *Institute of Botany, University of Bern*—\$10,000 for plant physiology research equipment; *University of Geneva*—60,000 Swiss francs for research in organic chemistry; *Centre National de la Recherche Scientifique*—\$54,000 for scientific equipment for the Institute of Genetics at Gif, France; *Uni-*

versity of London—\$37,000 for research in biophysics at King's College under the direction of J. T. Randall; *University of Manchester*—\$15,000 for research equipment in the Department of Organic Chemistry; *Montreal General Hospital, Canada*—\$30,000 for biochemical research directed by Juda H. Quastel; *National University of Colombia*—\$9,000 for fellowships for graduate students chosen from Faculty of Agronomy, Palmira, Colombia, to study under direction of the foundation's agricultural staff in Mexico; *Escola Superior de Agricultura "Luiz de Queiroz," Piracicaba, Brazil*—\$7,375 for equipment and supplies for the Departments of Agricultural Chemistry and Genetics; *Columbia University*—\$14,400 for research in biochemistry under David Shemin; *Long Island Biological Association*—\$45,000 for modernizing the Biological Laboratory physical plant at Cold Spring Harbor; *University of Wisconsin*—\$15,000 for research on the physical chemistry of proteins under direction of J. W. Williams, and \$30,000 for research in cytogenetics under direction of C. Leonard Huskins; *Smith College*—\$8,000 for research in genetics under direction of A. F. Blakeslee; *Genetics Society of America*—\$15,000, primarily for expenses of European scientists attending the society's Golden Jubilee meeting at Columbus, Ohio, in September; *Washington University, St. Louis*—\$31,200 for research in experimental embryology; *National Research Council*—\$60,000 for fellowships in the natural sciences.

Rockefeller Foundation grants for the second quarter of 1950 total \$2,143,633. This sum includes many small grants-in-aid, a few grants in the humanities, and other small grants not mentioned here.

Fellowships

The American Heart Association is accepting applications for research fellowships and fellowships for established investigators up to September 15. Applications for research grants-in-aid, including grants to basic sciences, may be filed up to December 15. The fellowships for established investigators are avail-

able to persons with M.D., Ph.D., or M.S. degrees who intend to make a career of research, and may be granted for a five-year period at a minimum stipend of \$5,000, with an annual increase of \$500. Research fellowships will be granted for a one-year period, with a stipend ranging from \$3,000 to \$4,300, and are open to graduates of medical and graduate schools who are interested in research. Grants-in-aid for a specified program of research are available to nonprofit institutions possessing adequate research facilities and experienced staff investigators. Information and application forms may be obtained from Dr. Charles A. R. Connor, Medical Director, American Heart Association, 1775 Broadway, New York City.

An annual lectureship covering the most significant single advance in the field of cancer research for the previous year has been established by the Bertner Foundation, of Houston, Texas, for the symposium on fundamental cancer research sponsored each year by the University of Texas M. D. Anderson Hospital for Cancer Research (*Science*, March 31, p. 347). A reciprocal exchange senior fellowship program has been established with the Memorial Hospital Center for Cancer and Allied Diseases, New York City. Each \$5,000 fellowship will be known as "The Jesse H. Jones Fellowship in Cancer Education Honoring Dr. E. W. Bertner." Further information regarding the lectureship and fellowship may be obtained from William O. Russell, Chairman, Education Committee, University of Texas, 2310 Baldwin Street, Houston.

Colleges and Universities

The University of Pennsylvania has established a school of auxiliary medical services, offering programs of study in physical and occupational therapy. The School of Physical Therapy of the Graduate Hospital of the university and the Philadelphia School of Occupational Therapy will be merged with the new units. Two courses of study are offered in each division—an undergraduate program leading to the Bachelor of

Science degree, and a certificate course for postgraduate students. Students will have a period of practical experience in hospitals and special institutions having therapy departments for clinical training, after completion of the course. Wesley G. Hutchinson, associate professor of microbiology at the university, has been appointed dean of the new school. Applications are now being accepted for admission, and the school will begin operation in September, with the opening of the 1950-51 academic year.

The University of Michigan will use funds from its Michigan Memorial-Phoenix Project, a \$6,500,000 alumni-sponsored program to establish an atomic research center at the university, to investigate the design and construction of an atomic engine. The research, headed by Paul F. Cene, professor of engineering mechanics, will be entirely unclassified, but liaison on a secret level will be maintained with the Atomic Energy Commission, to prevent duplication of effort.

Meetings and Elections

The summer meeting of the American Crystallographic Association will be held August 21-25, at the New Hampton School, New Hampton, New Hampshire.

The Biological Photographic Association will hold its 20th anniversary meeting at the Hotel Sheraton in Chicago, September 6-8. Papers will be presented on surgical motion picture photography, photomicrography, photography of surgical specimens, copying of x-ray films, stereophotography, legal aspects of patient photography, and preparation of prints for publication. A special feature of the meeting will be demonstration periods on photographic techniques. For further information, write Ralph Creer, American Medical Association, 535 North Dearborn Street, Chicago.

The International Congress of Psychiatry, meeting in Paris, September 18-27, will include in its program many aspects of psychiatry, psychosomatic medicine, and psychol-

ogy. Seven plenary sessions will be held, followed by discussion-debates and informal symposia. In addition to these, exhibits of psychopathological art and of the history and progress of psychiatry will be shown.

American psychiatrists who will present papers are: Walter Freeman, professor of neurology and neurosurgery, George Washington University, Washington, D. C.; Manfred Sakel, New York City; L. J. Meduna, associate professor, University of Illinois College of Medicine; Franz Alexander, director, Institute for Psychoanalysis, Chicago, and clinical director of psychiatry, University of Illinois College of Medicine; Maurice Levine, professor of psychiatry, University of Cincinnati College of Medicine; Raymond de Saussure, New York City; Franz Kallman, associate research medical geneticist, New York State Psychiatric Institute, Columbia University; and David Rapaport, Austen Riggs Foundation, Stockbridge, Massachusetts. Further information about the congress may be obtained from the Director of Publicity in the U. S., 200 Retreat Avenue, Hartford, Connecticut, or from Congrès International de Psychiatrie, 1 Rue Cabanis, Paris 14, France.

The Medical Library Association held its 49th annual meeting in Boston, June 19-22. Officers for 1950-51 are: president, Marjorie J. Darach; past president, Sanford V. Larkey; vice president (president-elect), Margueriete Prime; honorary vice president, Henry R. Viets; secretary, Caroline W. Riechers; and treasurer, Frederick G. Kilgour.

Industrial Laboratories

Hyland Laboratories, Los Angeles, announces the availability of a specially processed dried plasma which retains the antihemophilic properties of whole blood. The plasma is not curative but will impart normal clotting characteristics to hemophilic blood. A single dose will maintain normal clotting time for a period of several hours, and through repeated doses, clotting may be maintained indefinitely.

The Atlantic Refining Company is conducting a program of advanced petroleum research at its Philadelphia laboratories. Working with radioactivated engine parts, the effect of motor oils on wear in automotive engines can be measured with more accuracy than has been possible before. The amount of radioactive iron particles worn from the engine can be measured by determining the radioactivity of the used oil, and the wear caused by the oil can be calculated. The use of atomic radiation is being extended to experimentation with other petroleum products and processes.

McNeill Laboratories, in Philadelphia, has appointed Cornelius K. Cain, assistant professor of organic chemistry, Cornell University, as manager of the Department of Organic Chemistry, Division of Medical Sciences. He will direct the synthetic organic research activities of the company. Dr. Cain spent two years at the University of Illinois as a post-doctorate fellow, working with Roger Adams, head of the Chemistry Department, University of Illinois, on the chemistry of marihuana.

A model pathology laboratory is being established in Atlanta, Georgia, by the Public Health Service Communicable Disease Center, the Grady Memorial Hospital, and the Emory University School of Medicine. The new laboratory plans to develop, through research, more reliable methods for clinical laboratories throughout the U. S. and to educate and train laboratory personnel. F. William Sunderman, who has been in charge of the Clinical Pathology Section's laboratory services at the Communicable Disease Center since early March, has been named director of the new research center.

Detection and control of cancer-causing materials in everyday life is the purpose of a research program being conducted by The Cancer Prevention Committee at the Institute of Industrial Medicine, New York University-Bellevue Medical Center, New York City. Announce-

ment of the program was made on July 18 at a meeting of the Fifth International Cancer Congress in Paris. William E. Smith, staff member of the institute, is chairman of the committee, which includes laboratory workers, representatives of university research programs, manufacturers, industrial physicians, engineers, industrial and governmental hygienists, and statisticians, from various parts of the world. Valuable data concerning certain types of cancer-producing materials have already been developed by the committee and passed on to the industries directly concerned.

A Sourcebook on Atomic Energy, by Samuel Glasstone, will be published by D. Van Nostrand Company, under contract to the Atomic Energy Commission. The book presents the nonsecret scientific and technical aspects of atomic energy, and is particularly suitable for college students, teachers, textbook authors, and publishers. Its preparation was undertaken by the AEC as the result of a recommendation made by a committee of the American Textbook Publishers Institute, in 1947. The book will be available about December 1, at a retail price of \$2.90.

Recently Received

Directory to Marine Laboratories of the United States and Canada. Robert W. Hiatt. Contribution No. 4, Hawaii Marine Laboratory, Honolulu, T. H.

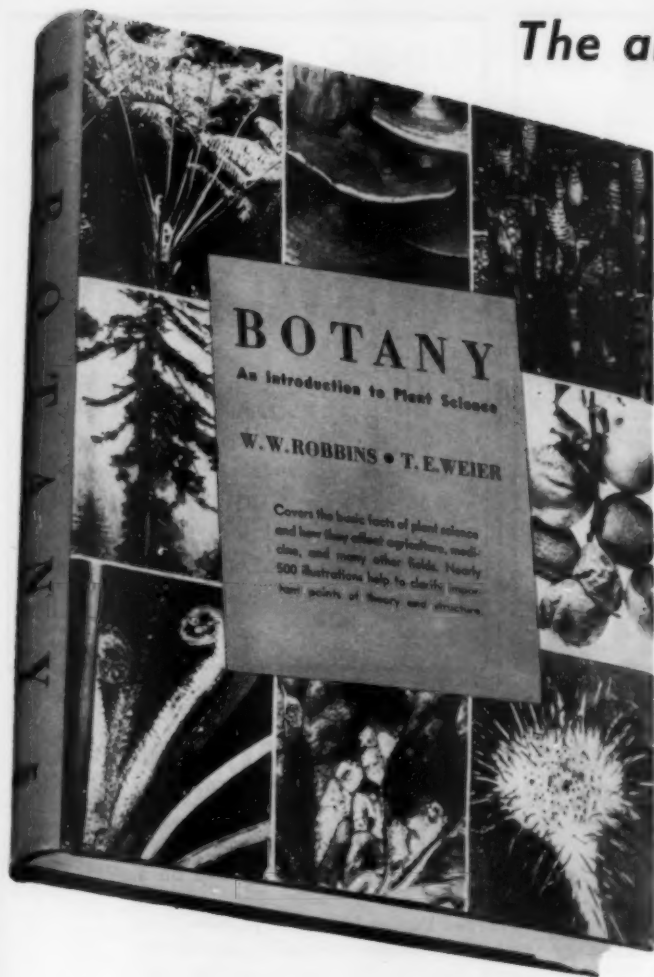
Transactions of the Astronomical Observatory, Yale University. Vol. 20. Catalogue of 7996 Stars +1° to +5°. Ida Barney. Published by the Observatory, New Haven, Conn.

Graphical Symbols for Heat-Power Apparatus. American Standards Association, 70 E. 45th Street, New York City. 35 cents.

On the Accuracy of Economic Observations. Oskar Morgenstern. Princeton University Press, Princeton, N. J. \$2.00.

Conference on Problems of Aging. Trans. 10th and 11th Conferences, 1949. Josiah Macy Jr. Foundation, 565 Park Avenue, New York City.

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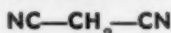
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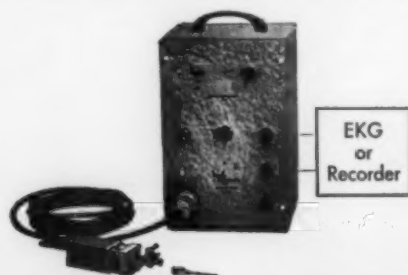


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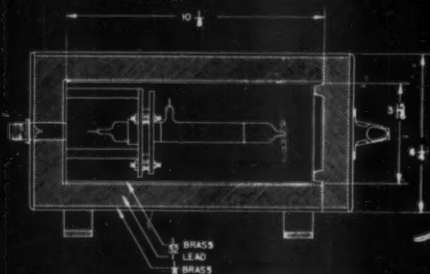
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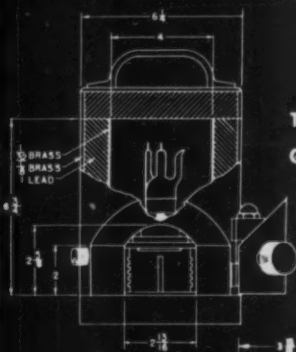
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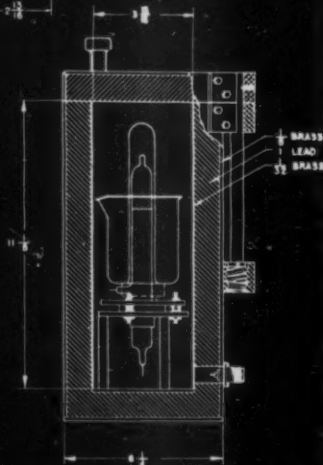


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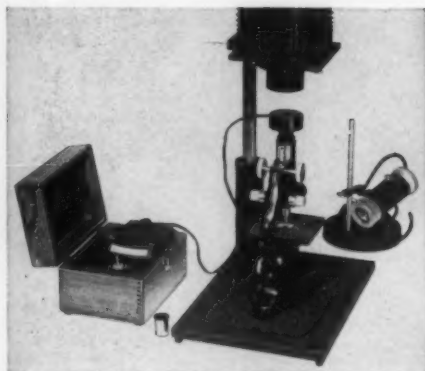
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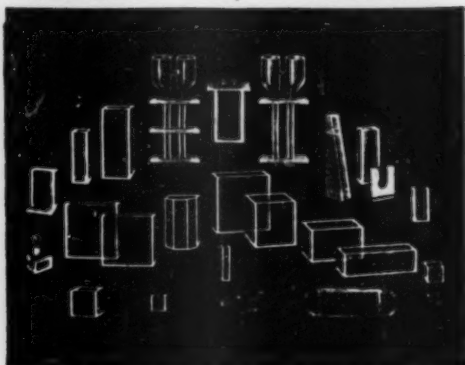
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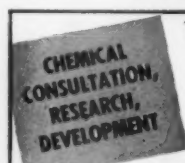
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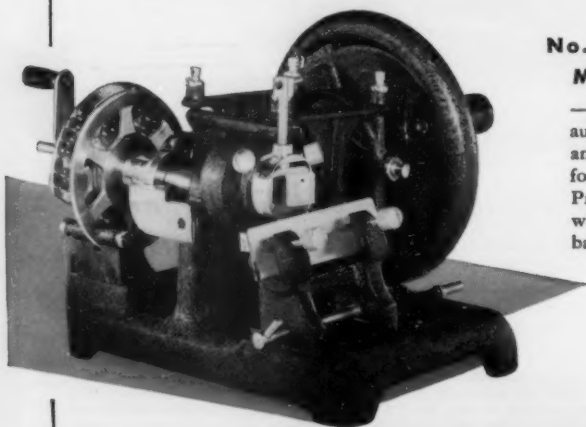
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